Joliet Junior College

Agriculture

Demonstration & Research Guide

2007

Prepared by: Jeff Wessel

Table of Contents

Table of Contents

Acknowledgements

Numerous people have contributed in many ways to the J.F. Richards Land Laboratory, Demonstration & Research Farm during 2007. Resources donated range from the time donated by drivers for our field day, to equipment, pesticides and seed, all are listed in the paragraphs below and table on the following page. Take some time to review these people and their supporting employers and offer them thanks for their support from Joliet Junior College and myself.

A few individuals I would like to mention here are Alan Venters with Garst, and Kelly Lobdell with Trelay for assisting in the planting of our corn hybrid demonstration. Lucia Douglas helped for the entire growing season as a student intern. She is responsible for collecting much of the data throughout the growing season, and we are in her debt. During our much anticipated annual root “digs”, Todd Thumma and Alan Venters of Garst, along with Mark Chastain of AMVAC, and Andy Rousonelos helped dig roots.

We would also like to thank a number of people who have so generously donated crop protection products. Matt Foes with Monsanto, Rich Porter with AMVAC, Jeremy Borms with Hintzsche Fertilizer, and Alan Hopkins with Dupont.

The Tordai family volunteered their time, a combine, grain cart, and semi’s for an entire day to help harvest our corn hybrid demonstration and the remaining acreage at the John H. Weitendorf Agriculture Education Center. Our field day speakers were; Dr. Carl Bradley, Russel Higgins, and Dr. Joe Spencer, all associated with the University of Illinois, and Don Rhoads with Burrus Power Hybrids.

Acknowledgements

[redacted]

Faculty and Staff of the Agriculture and Horticulture Sciences Department

The agriculture and horticulture faculty and staff at Joliet Junior College are always willing to answer questions and discuss the information contained within this document. As an institution of higher learning we value the discussion of the contents of our demonstration and research guide, and desire input from the public concerning our farm. Below is a complete list of all faculty and staff in the Agriculture and Horticulture Sciences Department. For more information or additional copies of the JJC Demonstration and Research Guide 2007, contact: Jeff Wessel, Joliet Junior College, 1215 Houbolt Road, Joliet, Illinois 60431. Phone: (815)280-6602 e-mail: jwessel@jjc.edu. To contact faculty and other staff members call (815)280-2320, or fax at (815)280-6650.

[redacted]

Introduction

The Joliet Junior College J. F. Richards Demonstration and Research Farm was put into operation in 1983 with the expressed purpose of being an educational resource for agricultural students and their instructors. There are three major objectives of the Demonstration and Research Farm, they are: 1) Provide an instructional setting for crops and soils analysis, this allows students to put into practice skills they have learned in the classroom. 2) Demonstrate crop response to various agronomic practices, this provides an environment for students to observe firsthand the impact of various agronomic practices on crop growth and development. 3) Provide unbiased, sound agronomic information to crop producers.

The Demonstration and Research Farm consists of 108 cropped acres with 58 acres of corn and 50 of soybean in 2007. Fifteen agronomic studies and two demonstrations were implemented; they included the evaluation of corn and soybean herbicides and insecticides, tillage systems, row spacing and plant populations, and planting dates in both corn and soybean. Nitrogen (N) fertilizer rates and corn root protection were among other replicated studies. Demonstrations (unreplicated) of corn and soybean varieties were also included.

Our Demonstration and Research Farm is situated in Joliet, Illinois (North Eastern Illinois) a region dominated by soils with low phosphorous (P) supplying power and high cation exchange capacity. Soil fertility levels at the Demonstration and Research Farm are within acceptable ranges for row crop production. P soil levels range from 50 to 140 with a median of 69 lb available P per acre, and exchangeable K^+ ranges from 277 to 502 with a median of 360 lb per acre. Soil pH ranges from 5.6 to 7.4 with an average of 6.7. Given these soil fertility levels, maintenance fertilizer P and K are applied annually at a rate of 50 lb P_2O_5 and K_2O per acre. The five year moving average yield for corn and soybean is 174 and 50 bushels per acre respectively.

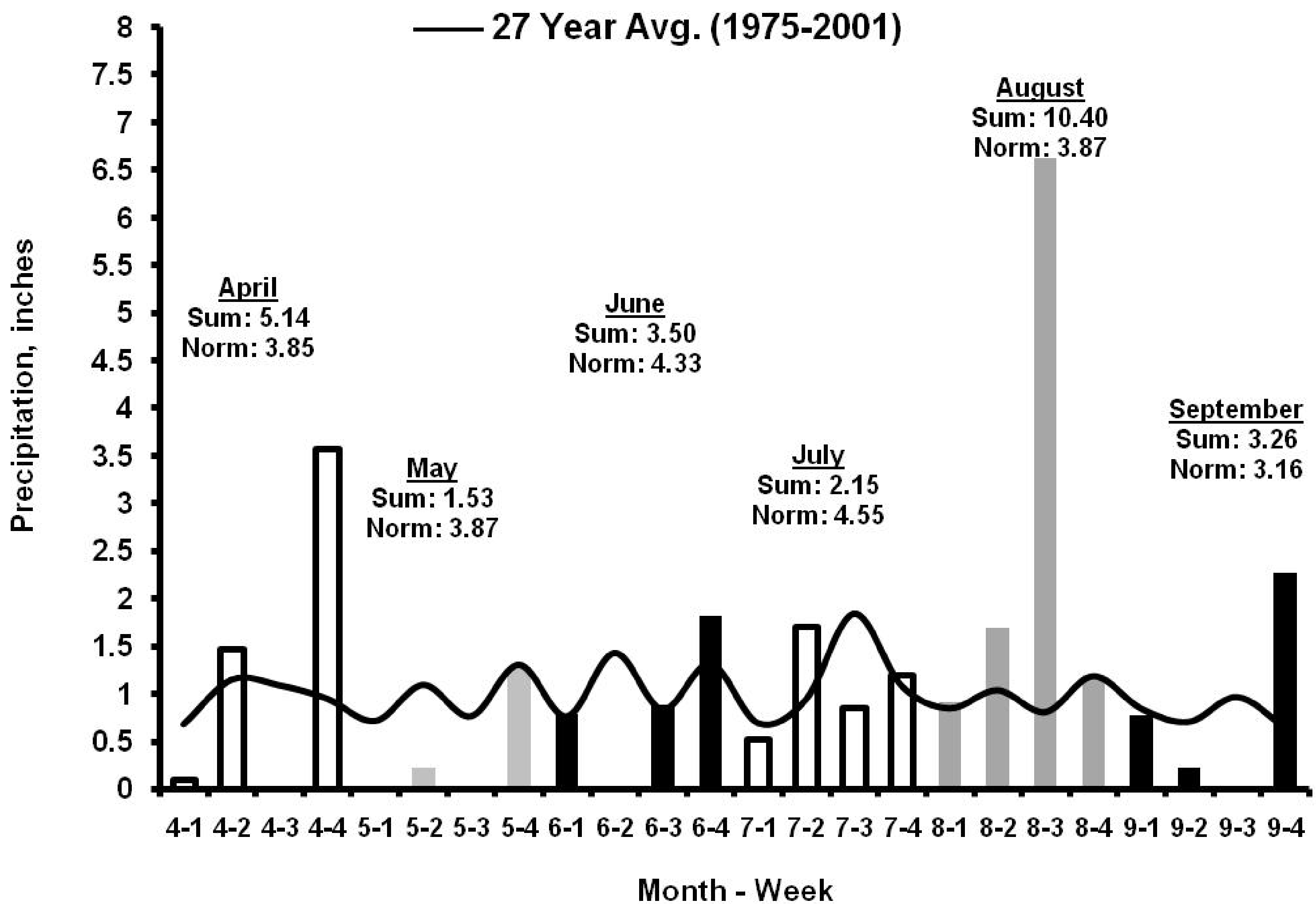
Zero tillage is the primary tillage system used, thus fall, spring preplant, or spring preemerge “burndown” herbicides are used to kill existing vegetation. Fall preplant burndown herbicides were applied in November of 2006 where soybean

Introduction

was to be planted in 2007 and included CanopyEX + 2,4-D. For corn, spring applied preemerge burndown herbicides consisted of Roundup Weather Max + 2,4-D. In addition to the burndown, weed control in corn was accomplished by preemerge applications of HarnessXtra followed by postemerge applications of Roundup Weather Max or Impact, or by postemerge applications of SteadfastATZ+Impact. Weed control for soybean, in addition to the fall burndown, was accomplished with a V4 application of Roundup Weather Max.

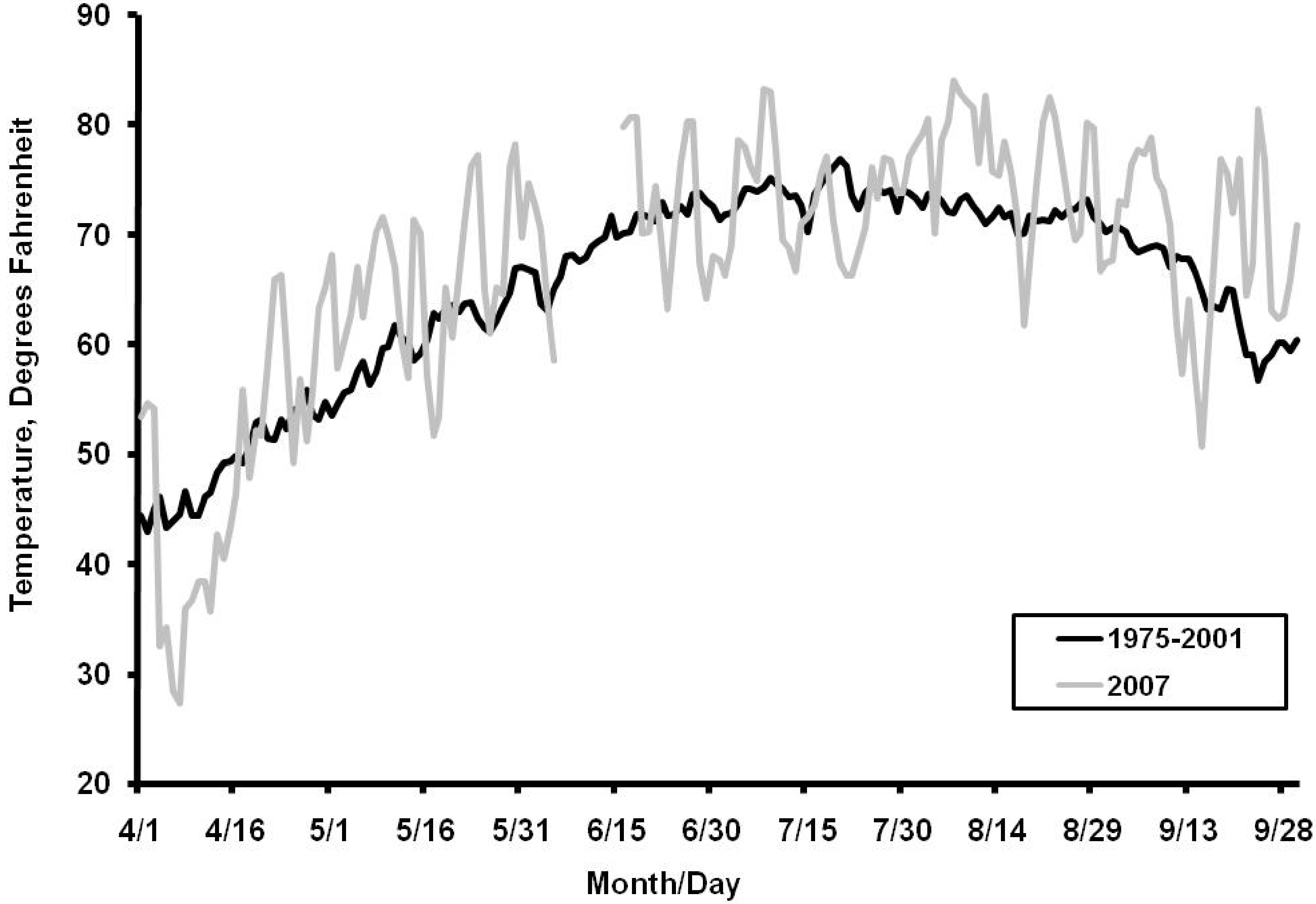
Both corn and soybean were planted using a Kinze model 3000 pull-type planter manufactured in 2002 and equipped with a colter and residue remover combination for zero-till planting. Corn was planted in 30 inch rows at a rate of 34,000 seeds per acre and planting dates for most corn in later April. Soybean was seeded at a rate of 150,000 seeds per acre in either 15 or 30 inch rows. Most soybean was planted the first week of May. Crops were harvested the second half of October. The average corn yield was 202 bushels per acre, while soybean averaged 58. Both crop yields were record highs for the JJC Demonstration and Research Farm.

Precipitation



Weekly precipitation at Joliet Junior College during the 2007 growing season (bars), and a 27 year average (black curve) from a nearby weather station.

Temperature



Average daily temperature at Joliet Junior College during the 2007 (gray curve) growing season, and a 27 year average (black curve, 1975-2001) from a nearby weather station.

Corn Rootworm Larval Control Products

Rationale

Corn rootworm (CRW) is the most damaging insect pest of mono-cropped corn in the Midwest (Levine and Oloumi-Sadeghi, 1996), and as such has the potential to inflict heavy economic losses (Gray et al., 1993). Beginning in the 1980's, this pest has inflicted an estimated one billion dollars of annul losses to U.S. corn producers through yield reductions and the cost of control measures, and hence has earned the nickname "the billion dollar pest" (Metcalf, 1986). Prior to 1995, rotated corn in Illinois was not vulnerable to root injury from Western Corn Rootworm (Spencer et al., 1997). Since 1995 however, a variant western corn rootworm exhibiting a behavioral shift to oviposition in crops other than corn has resulted in a failure of crop rotation to control WCR in first year corn fields (Levine et al., 2002).

Figure 1 depicts a dramatic increase in first-year corn acres at risk from corn rootworm larval injury in 2005 compared to 1999. In 2005 all Illinois corn producers were at some risk of seeing first-year corn injured from corn rootworm larvae, compared to only about ¼ in 1999. The latest development has been the expansion of the variant into Southern Illinois (South of I-70) as reported by Steffey (2005). Our objectives were to evaluate the efficacy of corn rootworm larval insecticides (seed treatment & granular) and transgenic Bt-RW corn, and to determine the relationship between root injury ratings and corn grain yield.

Corn Rootworm Larval Control Products

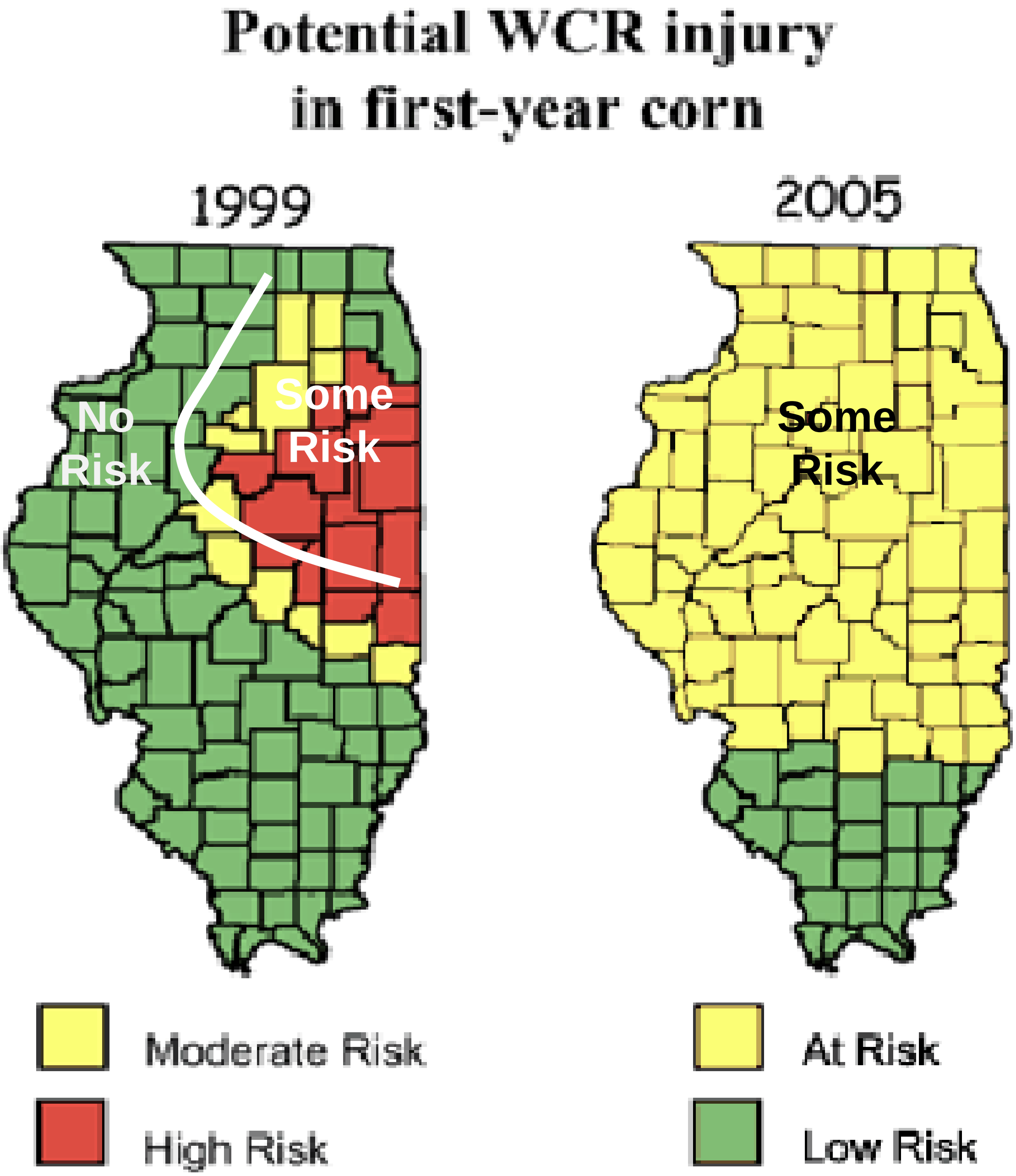


Figure 1. Possible injury from Western corn rootworm larvae in first-year corn fields in 1999 and 2005.

Source: University of Illinois Extension, IPM Field Crops. [Online] available at: http://ipm.uiuc.edu/fieldcrops/insects/western_corn_rootworm/index.html.

Corn Rootworm Larval Control Products

Methods

Five granular insecticides, one seed treatment, three different Bt-RW events, and an untreated control were evaluated for their impact on corn root injury from corn rootworm larvae and grain yield. The three Bt-RW events were; Monsanto's YieldGard RW (Cry3Bb1), DuPont's Herculex RW (Cry34Ab1/Cry35Ab1), and Syngenta's Agrisure RW (mCry3Aa). The three transgenic RW events were stacked with european corn borer resistance and herbicide tolerance. The YieldGard and Herculex RW events were contained in hybrids [Pioneer 36B03(YG+/RR) and Pioneer 36B05(HXX/RR/LL)] with the same genetic isoline [Pioneer 36B11(RR+CB)]. The Agrisure RW event however, was contained in a different hybrid [Garst 8573(CB/RW/LL)]. The isoline of the Pioneer brand hybrids [Pioneer 36B11(RR+CB)] was used for all six insecticides and the untreated control. The product rate of granular insecticides was (oz per 1000ft. of row); Lorsban15G (8), Fortress2.5G (7.35), Force3G (4), Counter15G (8), and Aztec2.1G (6.7). The seed treatment insecticide Poncho 1250 was applied at 1.25mg active ingredient (clothianidin) per kernel. All four hybrids were 106-day relative maturity, and all treatments replicated three times.

The previous crop was late planted corn (early June), in an effort to increase adult egg laying and hopefully larval populations the following season. The experimental area was moldboard plowed in the fall of the year, and shallowly disked in the spring. The crop was planted on April 21st, seeded at 34,000 seeds per acre, and 40 lb N/acre urea ammonium nitrate applied two inches to the side and two inches below the seed furrow. All granular insecticides were applied in the seed furrow through a planter-box attachment. Harness Xtra was applied at 60 oz/acre preemerge, followed by Roundup WeatherMax at 21 oz/acre postemerge (V3). At V5 the crop was sidedressed with 100 lb N/acre of urea ammonium nitrate. On July 6th (R1), five randomly selected plants from each plot were dug from the soil, washed, and rated for root injury on the 0 – 3 node-injury scale (Oleson et al., 2005).

Corn Rootworm Larval Control Products

Results

The untreated control had all three nodes of roots completely destroyed (Figure 2). The seed treatment insecticide Poncho 1250 had one half of the injury (1.5, 0 – 3 scale) observed in the control treatment. The five granular insecticides all performed similarly and reasonably well, they ranged from 0.48 (Counter) to 0.84 (Fortress). The three Bt-RW products generally performed similar to the granular insecticides, as both the YieldGard and Herculex RW technologies did not differ from any granular. The Agrisure RW product however, did result in greater root injury when compared to Counter and YieldGard RW. When Counter was added to YieldGard RW, no improvement in root protection occurred.

Grain yield for the untreated control was 142 bushels/acre (Figure 3), Poncho 1250 increased yield nearly 20 bushels/acre, and all five of the granular insecticides further improved yield to about 180 bushels/acre. The three Bt-RW control products averaged 195 bushels/acre, and when Counter was added to YG-RW no yield increase was observed.

Figure 4 depicts both root injury rating and grain yield for four selected treatments from 2003 through 2007. Root injury rating was very high ($\geq$ 2.5) in the untreated control in all five years. The control products however, did not always provide acceptable or consistent root protection. In 2003 and 2004 Lorsban had root injury levels nearly identical to the untreated plots, in the following years however (2005 – 2007), Lorsban reduced injury compared to the control. Force reduced root injury compared to the control in all years except 2006, while YGRW reduced injury relative to the control every year. Although YGRW only reduced root injury significantly (α= 0.10) compared to Force in one year (2003), numerically it always resulted in the least amount of injury.

With the exception of 2005, grain yield (Figure 4, top) was always increased with the use of Force or YGRW when compared to the untreated control, and this increase averaged (2003 – 2007) about 60 bushels/acre. Recently there has been much discussion concerning yield improvement with transgenic Bt-RW corn when compared to a traditional granular insecticide. There are reports and testimonials of very large increases (~50 bushels/acre), especially under droughty conditions. Despite severe root injury each year in our untreated control, grain yield between YGRW and Force treated plots has never differed. This is easily explained by noting statistically similar root injury ratings nearly every year. Numerically though, YGRW has consistently provided the greatest root protection.

The difference between Force and YGRW has ranged from 0.90 (2003) to 0.07 (2007). But despite large differences in root injury for 2003, yields of Force and YGRW were similar. Actual root injury ratings were 0.30 and 1.20 for YGRW and Force respectively, this level of injury is simply not high enough to elicit a yield response. Figure 5 depicts the yield response to increasing root injury. Yield is maximized and unchanged between 0 and 0.61 on the node-injury scale, furthermore economic injury (cost of yield loss = cost of control) does not occur until root injury exceeds 1.25. While it is clear root injury does impact yield, yield changes occur primarily at high levels of injury (> 1.5, 0 – 3 scale).

Corn Rootworm Larval Control Products

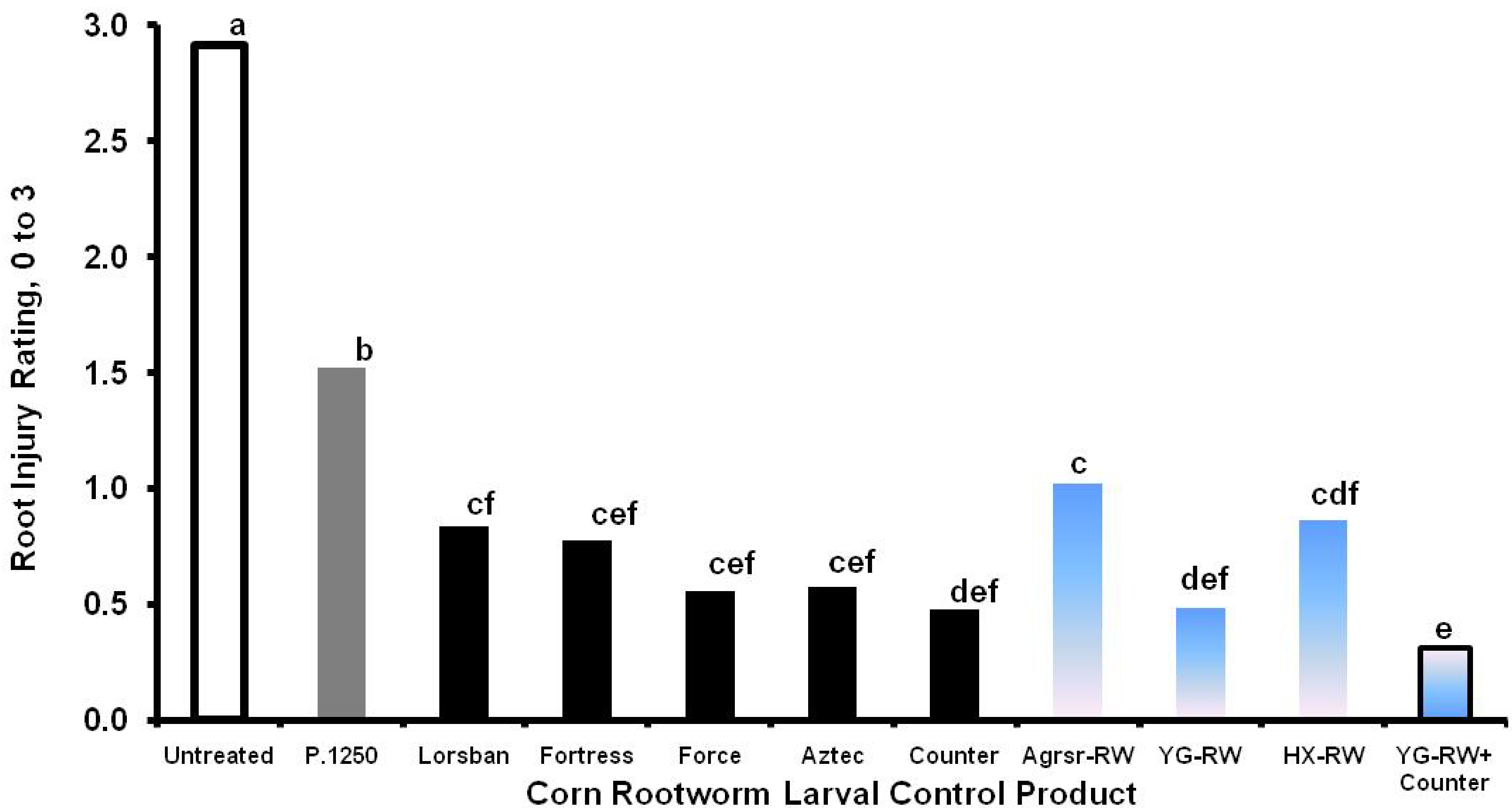


Figure 2. Influence of corn rootworm larval control product on the root injury ratings (0 to 3) of corn grown at Joliet Junior College in 2007. The corn hybrids are; Pioneer 36B11 used for all non-transgenic rootworm treatments, Pioneer 36B03 used for both YieldGard Rootworm (YG-RW) treatments, and Pioneer 36B05 used for the Herculex rootworm (HX-RW) treatment. The three Pioneer hybrids are isogenic lines. The Garst hybrid 8573 was used to represent Agrisure Rootworm (Agrsr-RW). Columns with the same letter are not significantly different (alpha= 0.10).

Corn Rootworm Larval Control Products

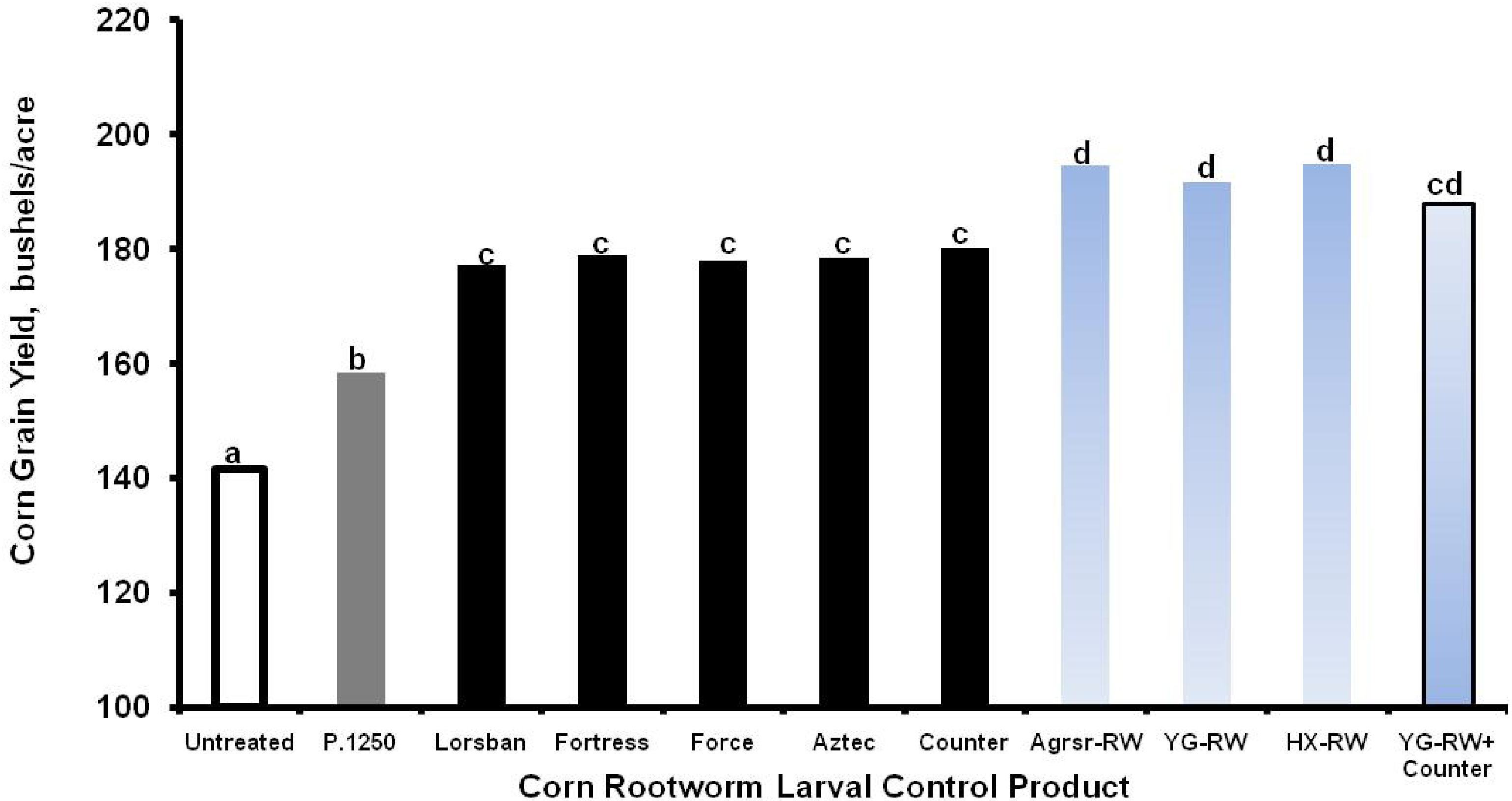


Figure 3. Influence of corn rootworm larval control products on the grain yield of corn grown at Joliet Junior College in 2007. The hybrids are; Pioneer 36B11 used for all non-transgenic rootworm treatments, Pioneer 36BO3 used for both YieldGard Rootworm (YG-RW) treatments, and Pioneer 36BO5used for the Herculex Rootworm (HX-RW) treatment. The three Pioneer hybrids are isogenic lines. The Garst hybrid 8573 was used to represent Agrisure Rootworm (Agrsr-RW). Columns with the same letter are not significantly different (α= 0.10).

Corn Rootworm Larval Control Products

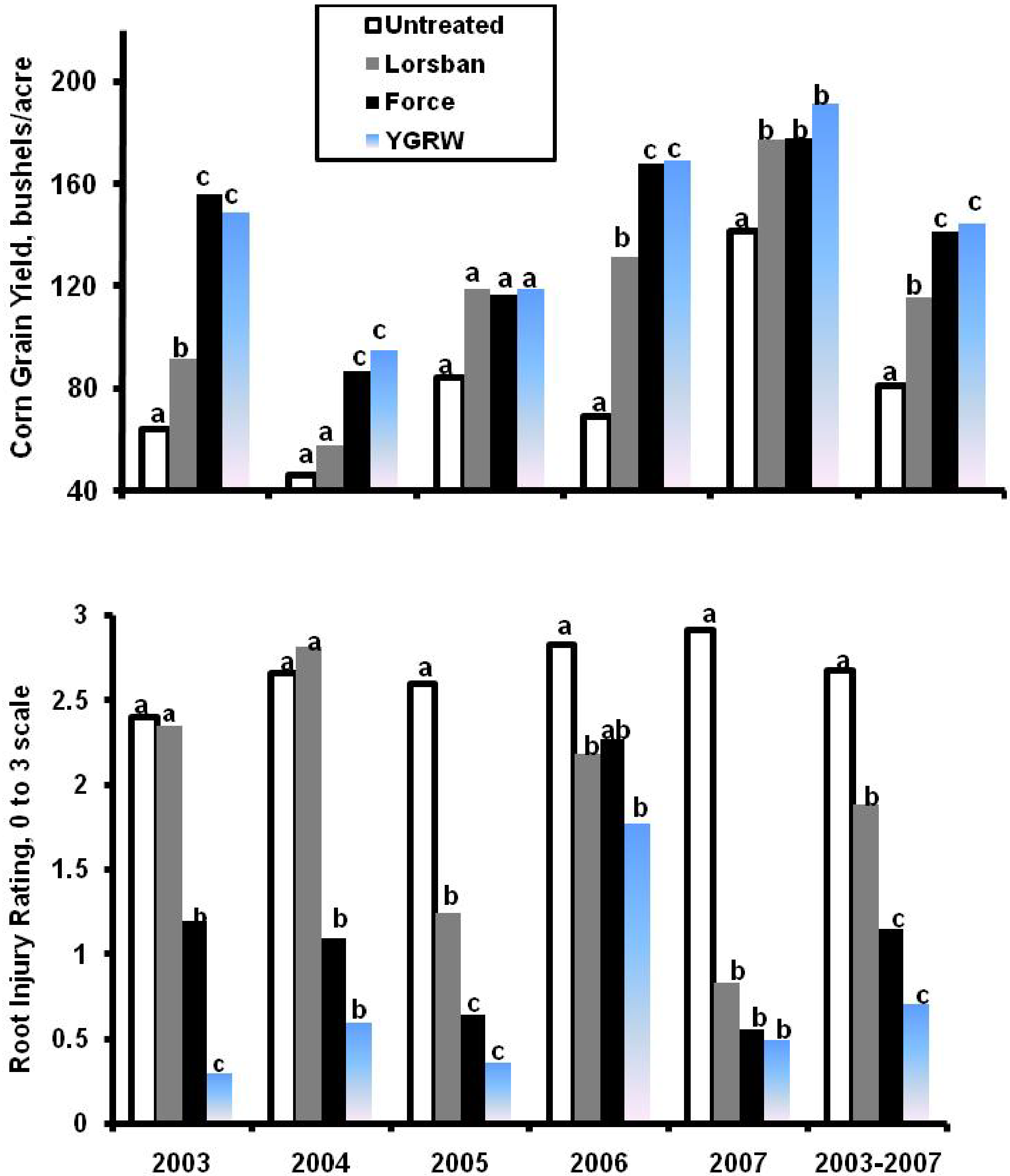


Figure 4. Influence of year and corn rootworm larval control product on the grain yield (top) and root injury rating (bottom) of corn grown after corn from 2003 through 2007. All treatment hybrids within each year were isogenic lines. Control products followed by the same letter within the same year are not significantly different (α= 0.10).

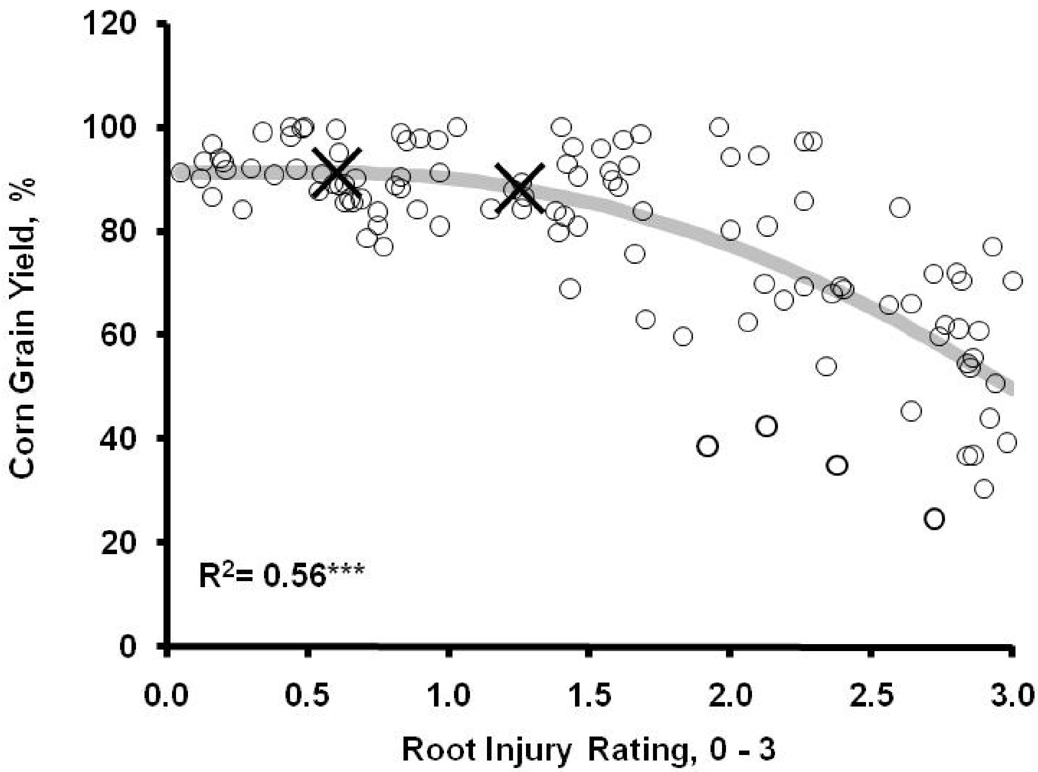


Figure 5. Influence of root injury (0 - 3, node-injury scale) on the grain yield of corn grown (%) at Joliet Junior College from 2003 to 2007. Each year corn was planted after a late planted trap crop of corn the previous year. The left X shape indicates the plateau yield (x= 0.61), while the right X indicates the economic injury level (x= 1.25). Economic injury level was calculated using 180 bushels/acre yield, \$4.00/bushel price, and \$20.00/acre treatment cost. "***" indicates a model p-value less than 0.001.

Root Protection and N Stress

Rationale

Nitrogen availability varies both spatially and temporally, both farmers and agronomists understand this and are constantly looking for management solutions to alleviate yield loss associated with nitrogen loss. Corn hybrids containing trans-genes of Bacillus thuringiensis (Bt) that produce insecticidal proteins with activity on corn rootworm larvae (Bt-RW) have the potential to reduce yield loss under N stress. We have noted, as have many others, the consistent and very good level of root protection afforded by YieldGard rootworm hybrids. A Bt-RW corn crop experiencing some N stress might be capable of maintaining a higher level of yield when compared to its isoline with poorer root protection. Additionally, a more recent Bt-RW event (Herculex rootworm) also has the potential to maintain yield under N stress. Our objectives were to determine if corn yield loss due to N stress could be lessened by improving root protection, and whether that interaction is consistent over YieldGard and Herculex rootworm technologies?

Methods

Nitrogen fertilizer was applied at either 40 or 120 lb N/acre to represent N stress and unstressed plants. Corn hybrids from DeKalb and Pioneer were grown with three levels of root protection which included an untreated control, a granular insecticide, and either YieldGard VT Triple (VT3) or Herculex Xtra (HXX) Bt-rootworm technologies. The hybrids were DeKalb DKC61-69 VT3 and its isoline DeKalb DKC61-73 YGCB/RR, 61-73 was used for the untreated and granular insecticide treatments. Additionally, the Pioneer hybrids 34A20 HXX and its isoline 34A17 HX/1 were used to represent a different hybrid and Bt-rootworm technology. Pioneer 34A17 was used in the untreated control and with the granular insecticide. All treatments were replicated four times.

The granular insecticide was Fortress 2.5G applied in the seed furrow at 7.35 oz/1000 feet of row. The previous crop was soybean and corn was planted on April 18th into fall strip-tilled soil. One pint of 2,4-D and 60 oz of Harness Xtra were applied pre emerge, followed by Roundup WeatherMax at 21 oz/acre applied post emerge. On July 13th (R1) three roots were randomly selected and dug from the soil of each plot, washed with a high pressure washer, and rated for injury from corn rootworm larvae (0 – 3, scale).

Results

Root injury varied considerably by a hybrid (DeKalb or Pioneer), by N level, by root protection treatment interaction (Figure 6). The two hybrids did not respond the same to N stress. In the untreated control only, N stress reduced root injury for the Pioneer hybrid. With the DeKalb hybrid however, N stress increased root injury. With both the granular insecticide and Bt-rootworm treatments, hybrid and N did not influence root ratings. Grain yield did not interact with hybrid, N level, or root protection treatment. Figure 7 has the main effects of root protection treatment for grain yield. The Fortress treated crop increased yield over both the untreated control and Bt-rootworm.

The completely different response to N stress by the two hybrids in the untreated control is quite interesting. Moderate N levels have been observed to produce the greatest root growth and injury from corn rootworm larvae (Costa et al., 2002). Conversely, Wessel (2007) observed decreasing injury with increasing N, attributed to enhanced root growth and a dilution of larval feeding. A number of cultural interactions have been documented with root injury, the impact of hybrid however, has not. We will continue this study with the same hybrids to determine if this interaction is consistent, or weather related. Practically, the hybrid with decreasing injury with the high-N treatment would be preferred by producers, as this level of N is more representative of typical conditions.

Root Protection and N Stress

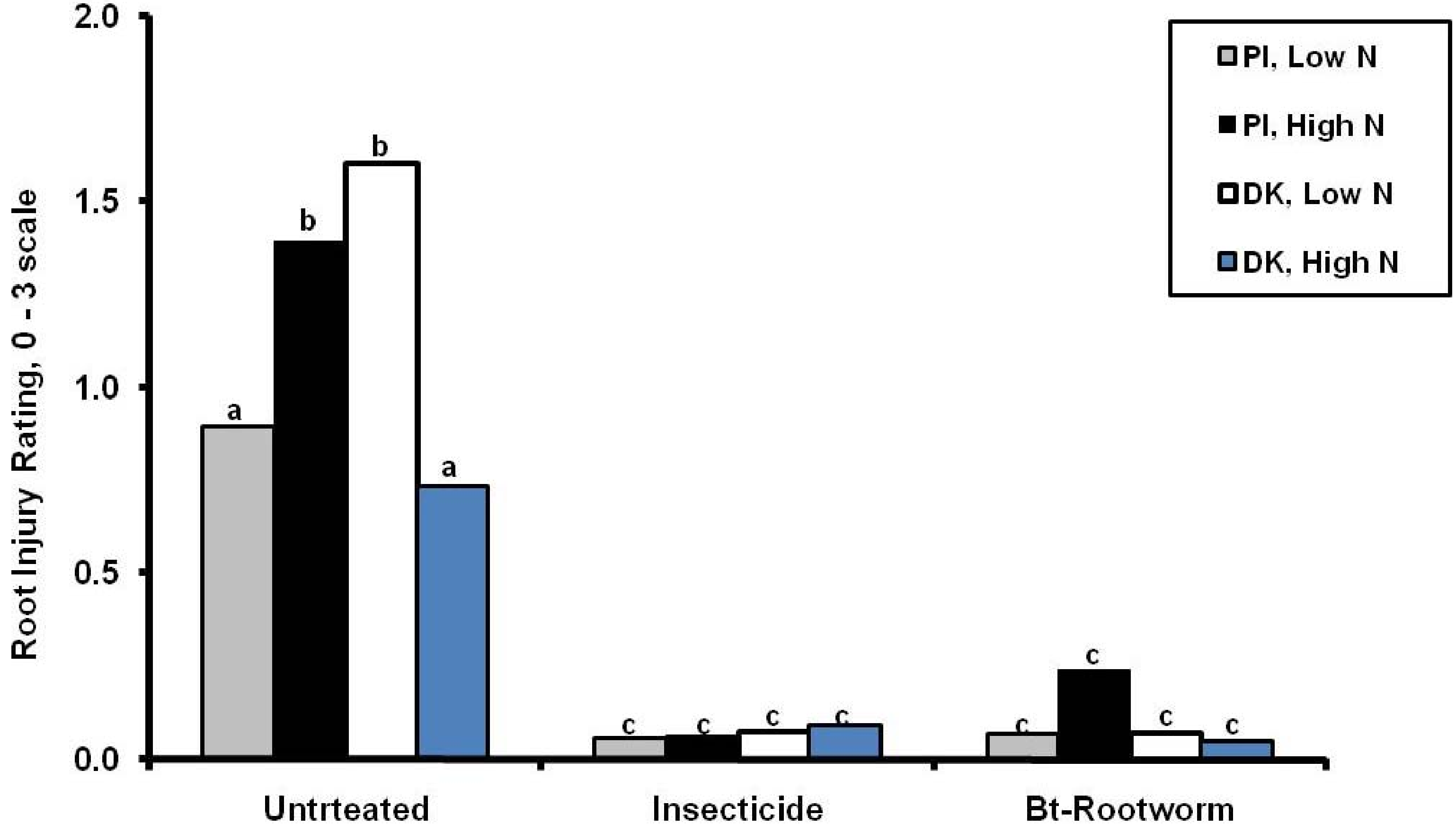


Figure 6. Influence of root protection treatment, hybrid, and N level on the root injury rating of corn grown at Joliet Junior College in 2007. The insecticide was Fortress 2.5G applied at 7.35 oz per 1000 feet of row. The two hybrids were either a Pioneer or DeKalb brand, both with and without Bt-rootworm. Low N plots received 40 lb N per acre, while high N received 120. Treatments followed by the same letter are not significantly (α= 0.10) different.

Root Protection and N Stress

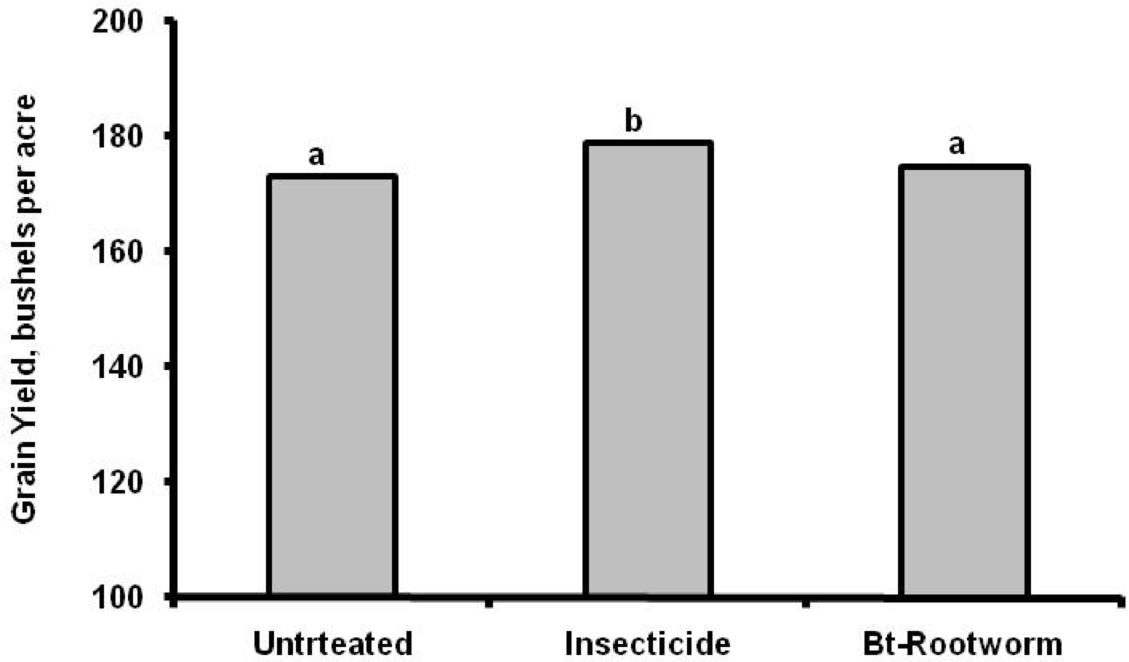


Figure 7. Influence of root protection treatment on the grain yield of corn grown at Joliet Junior College in 2007. The insecticide was Fortress 2.5G applied at 7.35 oz per 1000 feet of row. Data are the average of two hybrids [Pioneer (34A17 or 34A20) and DeKalb (61-73 or 61-69)] and N levels (40 or 120 lb N/acre). Treatments followed by the same letter are not significantly (á= 0.10) different.

Root Injury and Nitrogen Requirement

Rationale

Nitrogen (N) fertilizer is usually required by corn to maximize producer profitability. Numerous factors such as N application time (Welch, 1971), N placement (Roberts et al., 1995), use of nitrification inhibitors (Bundy, 1986), tillage (Stecker, 1993), grain yield and previous crop (Hoeft and Peck, 2002), soil N supply (Rehm et al., 1994), and soil N loss characteristics (Smith et al., 1983) can impact corn fertilizer N requirements. In many cases either one or a number of these factors vary from field to field with changes in management and soil characteristics.

Economics and environmental concerns are usually at the forefront of N fertilizer considerations. During the past decade there has been increasing interest over the efficiency by which N is used. The largest zone of oxygen depleted waters in the U.S., Northern Gulf of Mexico, is often the focal point of concerns over N fertilizer use efficiency. This hypoxic area is thought by some to be partially related to or caused by an increase in nitrogen loading in the Gulf, possibly due to N fertilizer loss from Mid-Western cropland (Rabalias, 1998).

One management factor not widely studied that may impact corn N requirements is root injury caused by corn rootworm. In one of two years with plentiful soil moisture Spike and Tollefson (1991) observed higher corn N requirements with increasing root injury, and yield reductions were overcome with higher fertilizer N rates. Alternatively, N requirements have been shown to be reduced with increasing root injury (Spike and Tollefson, 1989). Over-compensatory root regrowth (growth after larval injury) has commonly been observed when low to moderate levels of root injury occur (Riedell, 1989; Kahler et al., 1985; Spike and Tollefson, 1988). Extensive root regrowth, in addition to yield reductions, may partly explain the reduced N requirements observed in some studies. Our objective was to determine the impact of corn root injury from corn rootworm larvae on nitrogen requirement.

Root Injury and Nitrogen Requirement

Methods

Five nitrogen fertilizer rates (40-200 lb N/acre in 40 lb increments) and an unfertilized control were applied to three levels of corn rootworm larval control products. Control products were; no-insecticide, Fortress, YGRW+Fortress. Forty lb N/acre was applied during planting two inches to the side and two inches below each seed furrow to all treatments except the unfertilized control, and the balance of an N treatment sidedressed at V5 (early June). The N source was urea ammonium nitrate (32% UAN) injected four inches deep into every other row middle (60” spacing) during the sidedressing operation.

All treatments were replicated four times and arranged in a split-plot design, with rootworm control product as the main plots and N rate the sub plots. The corn hybrid Garst 8502 was used for the YieldGard Rootworm + Fortress plots, and its isoline Garst 8461 was planted for the untreated and Fortress plots. Corn was seeded at 34,000 seeds per acre in mid to late April. Fortress 2.5G was applied in the seed furrow, and weed control was achieved by preplant burndown herbicides, followed by a postemerge application of SteadfastATZ. Soybean was the previous crop, and this study was carried out over a three year period from 2005 to 2007.

Results

The untreated control in 2005 and 2006 had moderate to heavy root injury (Table 1), averaging about 1.5 nodes of roots destroyed (1.5, 0 – 3 scale). In 2007 however, the untreated plots averaged 0.19, and all root protection treatments produced similar levels of injury. In 2005 and 2006 Fortress reduced root injury when compared to untreated plots, but YGRW +Fortress did not further reduce injury. Although there was no statistical difference between the two control products, the YGRW+Fortress had numerically lower injury ratings compared to Fortress in both 2005 and 2006.

All three corn rootworm larval protection methods increased yield with increasing N fertilizer (Figure 8). The magnitude of yield was increased with either Fortress or YGRW+Fortress when compared to the control treatment, and both the Fortress and untreated crop had a similar response to N. The YGRW+Fortress treatment responded to N differently compared to both Fortress and untreated. At very low N rates (0 – 20 lb N/acre) yields of YGRW+Fortress were similar to the untreated crop, while at N rates greater than 80 lb yield was identical to Fortress.

Economic optimum N rates were (lb N/acre): Untreated= 132, Fortress= 155, and YGRW+Fortress= 140. The reduced N requirement of the lower yielding untreated crop is expected. Similarly, a decrease in N needed by YGRW+Fortress compared to Fortress is also expected, because greater root protection that results in a more voluminous rooted crop will increase N availability. The similarity between YGRW+Fortress and untreated without N fertilizer is not expected. Large amounts of root regrowth have been noted with low to moderate levels of injury (Wessel, 2007; Riedell, 1989). Therefore, it seems plausible that greater injury of Fortress and untreated enhanced root growth after injury ceased (regrowth), improving N availability and yield under extreme N deficit.

A question that could be raised though, is why YGRW+Fortress has a reduced N requirement without the benefit of root regrowth? The answer may simply be because during the majority of N uptake (V6 – R1), the untreated and Fortress plots had yet to benefit from regrowth. These findings indicate that fertilizer N requirement may be reduced (~10%) with the transgenic (Bt-RW) technologies, such as YGRW, compared to traditional approaches of root protection.

Root Injury and Nitrogen Requirement

Table 1. Influence of root protection method and year on the root injury rating of corn grown after soybean at Joliet Junior College. Roots were rated from plots with 120 lb N/acre. Root ratings followed by the same letter within a treatment are not significantly different (α= 0.10).

[redacted]

† 0 – 3 node-injury scale: 1= one node (circle) of roots pruned off to within 1.5 inches of the plant stem.

‡ LSD applies to root protection method within years.

Root Injury and Nitrogen Requirement

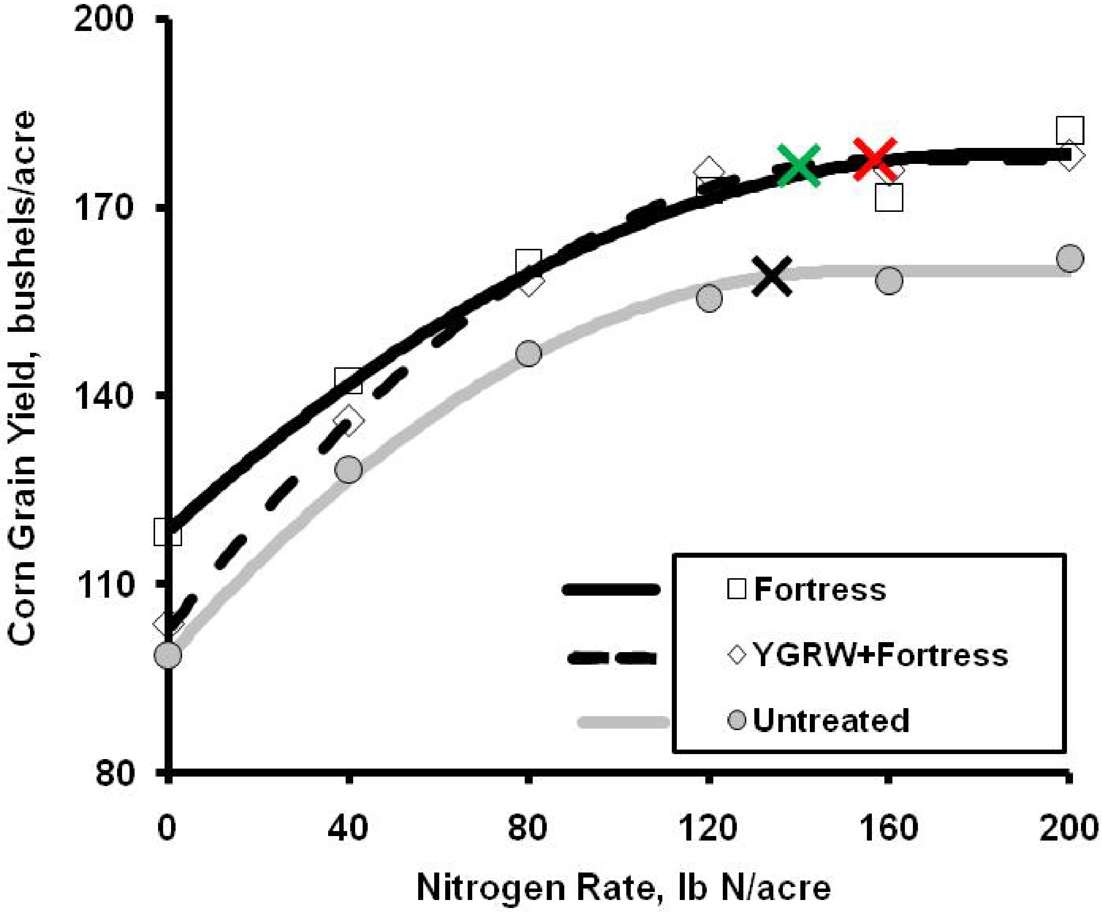


Figure 8. Influence of nitrogen rate and corn rootworm larval root protection methods on the grain yield of corn grown at Joliet Junior College from 2005 through 2007. Economic optimum N rates are (lb N/acre): Untreated= 132, Fortress= 155, YGRW+Fortress= 140, and are also indentified by an X associated with each curve. Nitrogen fertilizer to corn price ratio is 0.10 ($/lb N : $/bushel). All three quadratic plus plateau functions fit their respective data with p values < 0.001.

Tillage and Planting Date

Rationale

Optimum corn planting dates are well documented in Illinois, planting within the two week window between April 20th and May 4th usually produces optimum corn grain yields in most of Illinois (Nafziger, 2002). Tillage often produces small yield increases, although interactions with previous crop and soil water holding capacity have been noted (Hoeft et al., 2000). Corn zero-tilled after soybean and in droughty soils can produce yields similar to tilled soils, however, monocropped corn and corn grown in soils with relatively high water holding capacity often produce higher yields with tillage. The influence tillage has on optimum corn planting date is not well known. Observations made by researchers at Purdue from long-term tillage comparisons have been that a response to tillage is more likely when planting is done in late April compared to late May (Vyn et al., 2002). In Minnesota, Randall and Vetsch (2002) found no interaction between planting date and tillage. Our objective was to determine if tillage influences optimum corn planting date.

Methods

Three planting dates and tillage systems (9 treatments) were replicated three times to determine whether tillage influences optimum corn planting date. Tillage systems were zero, strip, and mulch tillage systems. Mulch tillage consisted of fall chisel-plowing followed by one spring shallow tillage operation. Strip-tillage consisted of fall tilled bands (~ 8-inches wide) with the tilled centers spaced 30 inches apart, and corn was planted into the tilled strips the following spring. Zero-till had no tillage performed at any time, and the previous crop was soybean.

The study was conducted over a four year period from 2004 to 2007, each year planting occurred in the 1st week of April for the early treatment, the last week of April for the normal planting time, and the third week of May for the late date. During the first three years the corn hybrid Burrus 644RWR was seeded at 32,000 seeds/acre, in 2007 a newer hybrid was selected (Burrus 572RWR) and 34,000 seeds/acre were planted. Weed control was achieved with preplant tillage and 60 oz per/acre HarnessXtra applied preemerge for tilled plots, and 16 oz/acre 2,4-D with HarnessXtra applied preemerge in strip and zero tillage plots. The entire experimental area was treated with Roundup Weather Max postemerge (V3) at 21 oz/acre. The nitrogen source was urea ammonium nitrate (32% UAN), 40 lbs N per acre applied 2X2 during planting and 80 lbs N per acre soil injected at V3.

Results

Optimum planting date was not influenced by tillage, it was however influenced by year (Figure 9). With the exception of 2007, the last two weeks of April each year were exceptionally warm. Two of those three years (2004 and 2006) the early planted corn produced higher yields than either the normal or late planting dates. In 2005 corn planted during the normal planting time produced the highest yield, but early planted corn suffered heavily from a mid-May hail storm. In 2007 planting date did not affect yield, and April temperatures were near normal.

Tillage also interacted with year, but the magnitude of yield differences due to tillage were much smaller compared to planting date (figure x). Tillage only affected yield in 2006, when zero-till reduced yield compared to either strip or mulch tillage. When tillage was averaged over planting date and year (data not shown) zero-till produced 172 bushels per acre, strip-till 175, and chisel-till 177. When planting date was averaged over tillage and year (data not shown) early planted corn produced 184 bushels per acre, normal 179, and late 162. Our data suggest that irrespective of tillage, producers concern themselves primarily with the timeliness of planting.

Tillage and Planting Date

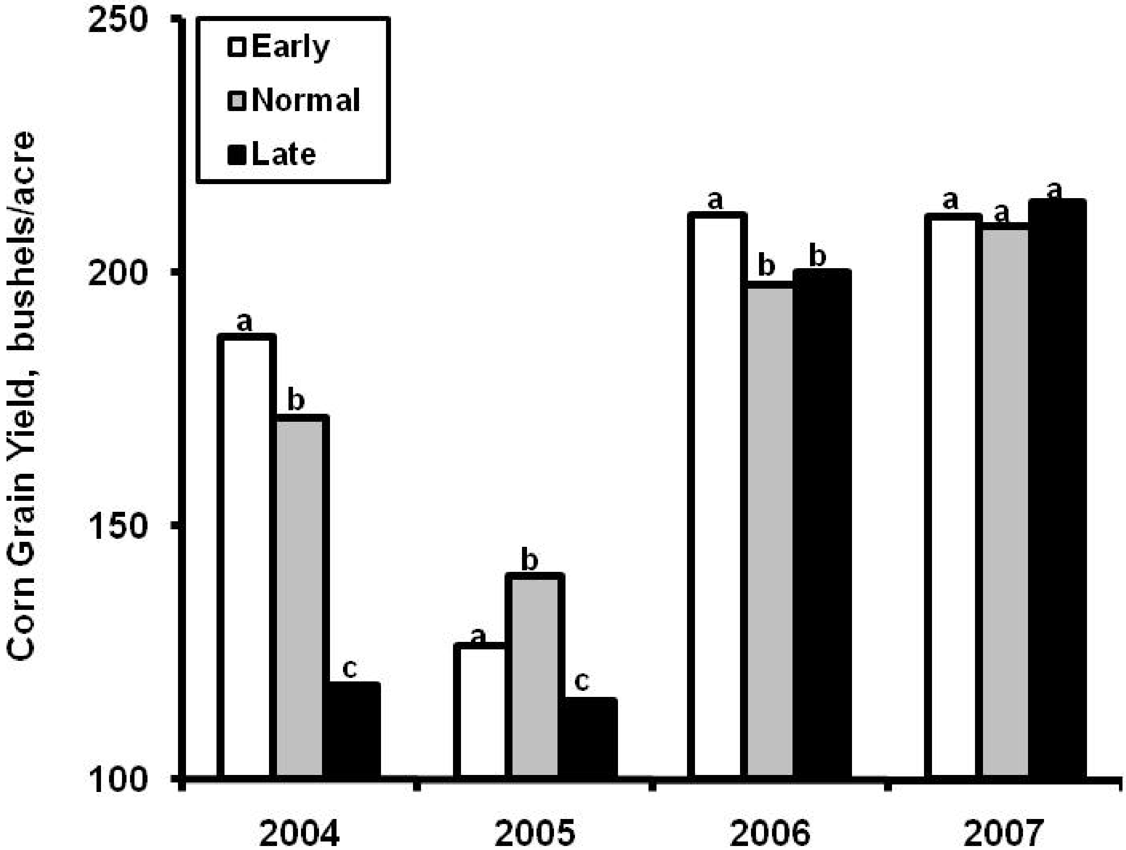


Figure 9. Influence of planting date (early= first week of April, normal= last week of April, late= third week of May) and year on the grain yield of corn grown at Joliet Junior College from 2004 through 2007. Tillage systems followed by the same letter within a year are not significantly different (α= 0.10).

Tillage and Planting Date

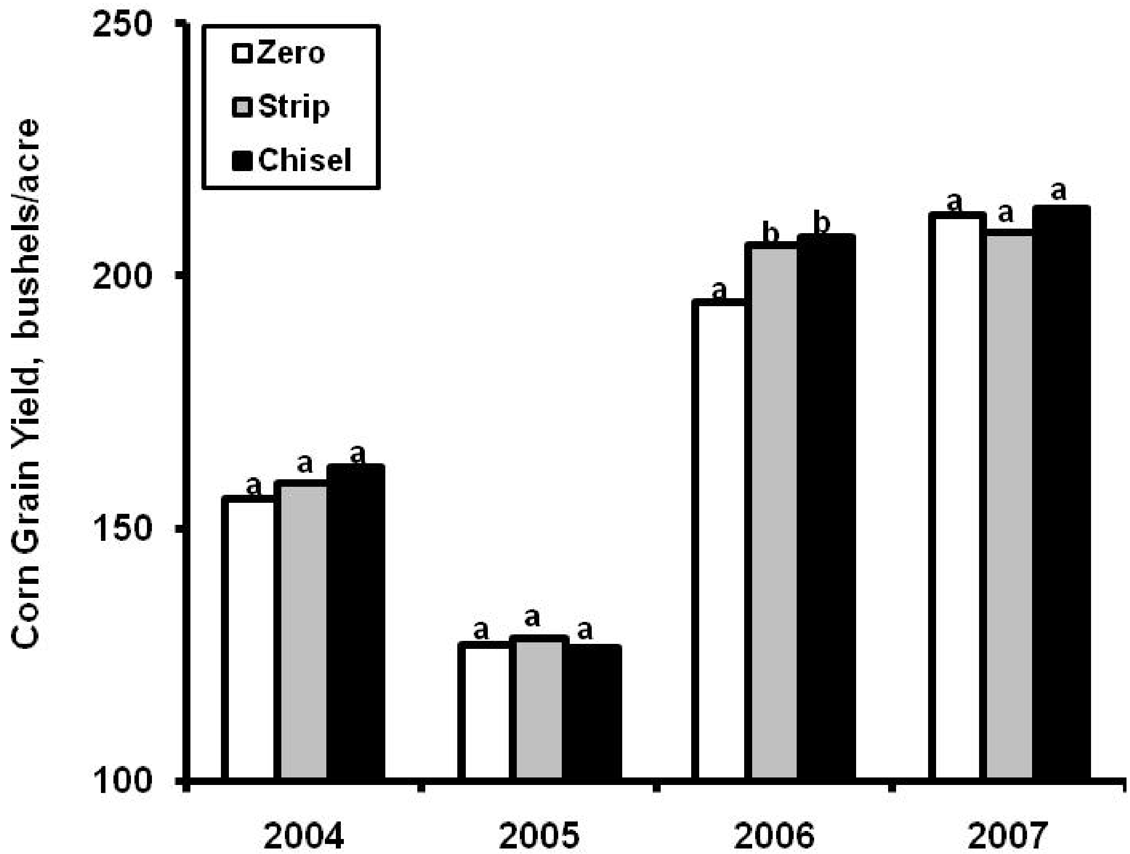


Figure 10. Influence of tillage and year on the grain yield of corn grown at Joliet Junior College from 2004 through 2007. Tillage systems followed by the same letter within a year are not significantly different (α= 0.10).

Continuous Corn Management

Rationale

Increased use of U. S. corn grain, primarily through the starch-based production of ethanol, has driven Illinois corn producers to plant a record number of acres to the crop in 2007. Increasing corn acreage in Illinois and elsewhere in the U. S. Cornbelt means an increased number of monocropped corn acres. Producers are often advised to manage their continuous corn acres differently than when soybean is the previous crop.

Hybrid selection is one criteria often cited by industry agronomists, residue management, including the use of both tillage and fall N application are also discussed as beneficial to monocropped corn. The potential benefits of foliar fungicides have been consistently promoted since the Asian Soybean Rust scare of 2005, and corn producers responded in 2007 by spraying an estimated three million acres. Our objective was to determine the impact of hybrid selection, tillage, N application timing, and fungicides on productivity of corn in a continuous corn setting.

Methods

Two tillage systems, two fungicide treatments, two N application times, and two hybrids were arranged in a split, split, split-plot using a randomized complete block design with three replications. The experiment consisted of 16 treatments. The two tillage systems were much or strip tillage. Strip tillage consisted of 8 inch wide strips of fall tillage running parallel to the crop rows. Mulch tillage consisted of fall discing followed by chisel-plowing with a three point hitch mounted chisel with three twisted shanks. Mulch tilled plots were also disked shallowly once the following spring. Tillage plots were split in half, with one half receiving the foliar fungicide Quadris at 7 oz per acre on July 15th (R1). The fungicide was applied with a high-clearance ground applicator using 30 gallons per acre carrier, and 35 lb per square inch nozzle tip pressure.

Each fungicide plot (with and without) was split in half, with one half receiving 40 lb N per acre of ammonium sulfate surface broadcast in November. Each fall N plot (with and without) was also split in half, and planted with either the Garst brand 8610, or 8573. Both hybrids contain the transgenic traits AgrisureRW, AgrisureCB, and tolerance to Liberty herbicide. The hybrid 8610 is not recommended for continuous corn production, while 8573 is promoted for monocropped corn. The previous crop was corn, and planting occurred on May 9th. A total of 160 lb N per acre was applied to the entire experimental area, and one quarter of that was applied during planting (2X2). The balance of N fertilizer, either 80 or 120 lb/acre with and without fall N respectively, was sidedressed on May 29th (V4) with 32% UAN injected into the soil

Results

Of the eleven potential agronomic interactions only one occurred. The two Garst brand hybrids did not respond the same to tillage (Figure 11). The hybrid 8610 produced the same grain yield in both tillage systems, while the yield of 8573 increased with chisel compared to strip. Figure 12 depicts the main effects (a treatment averaged over interactions) of the four treatment types. The use of a fungicide improved yield 6 bushels/acre, and chisel-plowing increased yield 7 bushels/acre compared to strip-till. Neither hybrid nor fall N affected yield.

It is somewhat peculiar that both hybrids performed similarly, as 8573 is considered a “good choice” by Garst literature, while 8610 is not recommended for continuous corn production. Perhaps even more peculiar though, is the hybrid by tillage interaction. We might expect a poorer performing hybrid for monocropping

(8610) to respond to tillage, while a more disease resistant hybrid (8573) to maintain yield despite the abundance of crop residue.

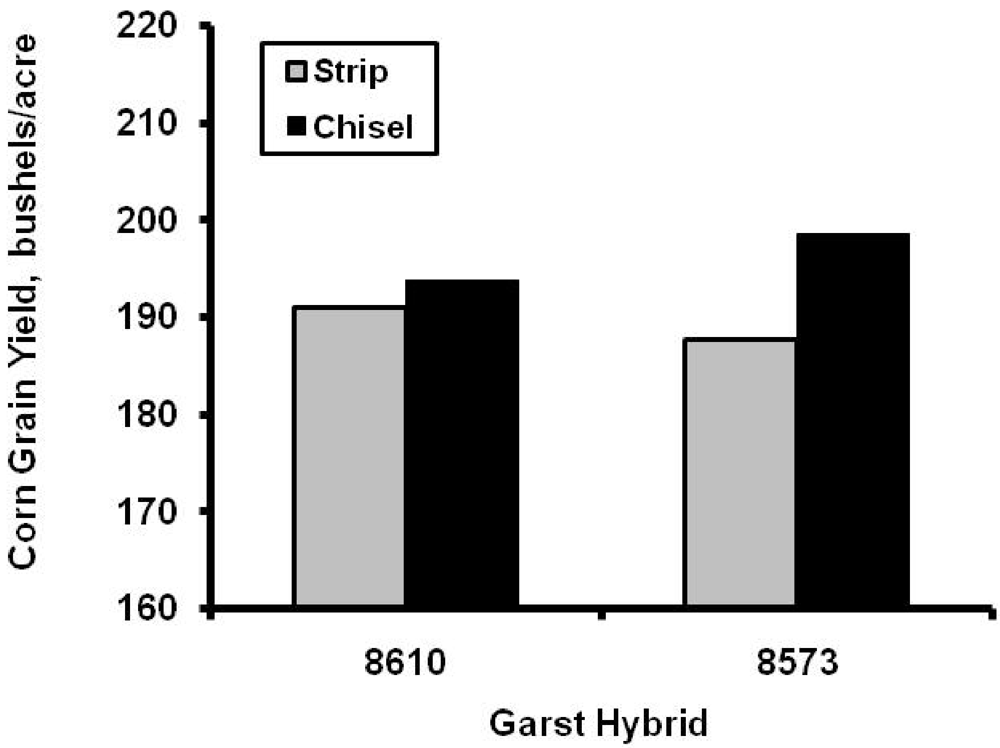


Figure 11. Interaction of hybrid and tillage on the grain yield of corn grown after corn at Joliet Junior College in 2007. Strip and chisel tillage were completed in the fall, and the two Garst hybrids were European Corn Borer and Corn Rootworm resistant, with tolerance to Liberty herbicide.

Continuous Corn Management

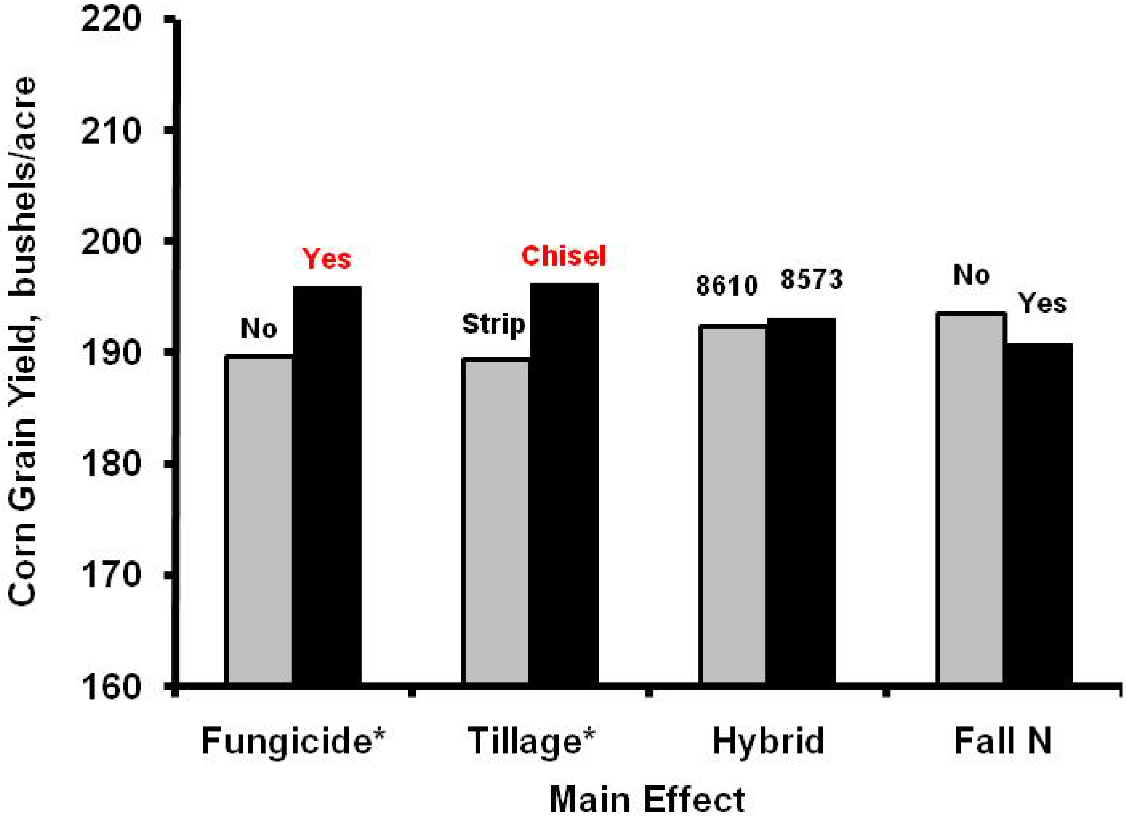


Figure 12. Influence of the main effects of four treatment types on the grain yield of corn grown after corn at Joliet Junior College in 2007. The fungicide Quadris was applied at R1, strip and chisel tillage was performed in the fall, and two Garst hybrids (CB/LL/RW) were planted in early May. A total of 160 lb N/acre was applied to the entire experimental area, and half of plots received 40 lb of their total in the fall. "*" indicates a significant difference (P<0.10) within a main effect.

Soil Fertility

Rationale

Optimum soil phosphorous (P), potassium (K), and acidity levels are critical for corn and soybean production in the Mid-Western United States. Soil P and K, and pH levels for crop production in Illinois are well established (Hoeft and Peck, 2002). There is a tendency however, for some Illinois crop producers maintain soil fertility above levels considered sufficient. Corn grain yields in Illinois from 1998-2002 averaged 144, and soybean 43 bushels per acre (University of Illinois, 2003). Average annual removal of P2O5 and K2O given current yields in a corn soybean rotation is 49 and 48 lbs per acre P2O5 and K2O, however, additions of fertilizer P and K over a similar time period (1998 - 2001) was 76 (lbsP2O5) and 112 (lbsK2O) per acre per year (Illinois Agricultural Statistical Service, 2002).

Excessive applications of any fertilizer represent a misallocation of resources. Our objectives were two-fold. First, as an educational tool we will demonstrate production of corn and soybean with fertilizer applications equal to crop removal, and without fertilizer P and K. Finally we will provide information to crop producers demonstrating crop production with fertilizer applications similar to crop removal.

Methods

Six soil fertility treatments were implemented in the Fall of 2001 with the intention of maintaining them for long-term evaluation. The 2007 crop is the sixth harvested since the study was implemented. The normal treatment consists of a typical soil fertility program for corn and soybean production which includes soil pH maintained between 6.0 to 6.5 and annual applications of maintenance fertilizer P and K (50 lb/acre P2O5 and K2O). Two additional treatments are similar to the normal but are missing either the maintenance P or maintenance K, and a fourth treatment has no P or K applications. The fifth and sixth treatments were included with the intention of reducing and increasing soil pH. The acidic treatment receives no liming material while the basic receives threefold the recommended lime. All fertilizers and liming materials are broadcast on the soil surface, and the crop zero tilled.

Soil samples were taken and analyzed in the Fall of 2001. Soil K levels (363 lbs/acre exchangeable K+), are considered sufficient for row crops in North Eastern Illinois, requiring only maintenance K (Hoeft and Peck, 2000). Soil P levels (44 lbs/acre available P) are slightly below the point at which only maintenance P would be necessary. Soil pH ranges from 5.9 to 7.4, somewhat high because of the calcareous nature of the parent material which is a loamy gravel with rock fragments of dolomitic limestone (Wascher et al., 1962). The depth to the parent material is fairly shallow (2 to 3.5 feet) and in a few areas may only be covered with 15 inches of solum. The course textured and shallow parent material reduces the soil water holding capacity and makes the crop very susceptible to water stress when less than normal rainfall occurs.

Results (Corn)

The year 2007 was the only time that all soil fertility treatments produced a yield less than the control treatment (Figure 13). In 2005 however, the lowest yielding year, all treatments tended to produce yields greater than the control. In the other three years (2003, 2004, and 2006) treatments not containing K fertilizer always produced yields less than the normal treatment. Conversely, the basic and acidic treatments always produced yields similar to or greater than the normal treatment.

Soil Fertility

Results (Soybean)

Most soil fertility treatments in most years produced yields less than the normal treatment (Figure 14). An exception is the acidic treatment, which has produced very similar yields to the normal treatment every year. The treatment without fertilizer P has also tended to produce yields similar to the normal treatment. Treatments not containing any fertilizer K nearly always reduced yield. In fact the lowest relative yield for corn or soybean ever observed in this study (87%) occurred in 2007 where no K was applied.

Soil Fertility

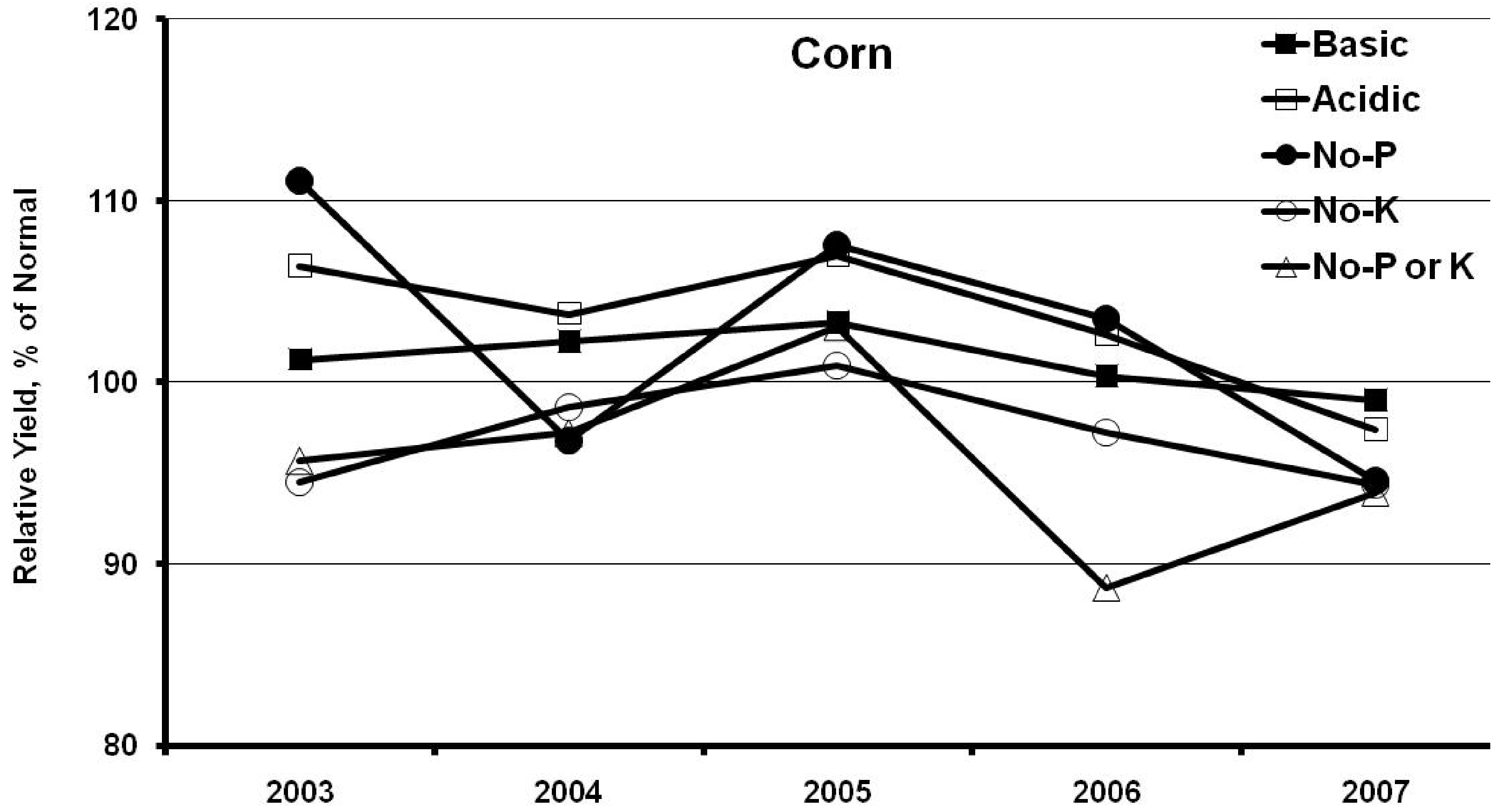


Figure 13. Influence of soil fertility practices and year on the relative grain yield of corn grown at Joliet Junior College from 2003 through 2007. Yields of all five fertility practices are depicted as a percentage of the normal treatment, which is 100. The normal treatment consisted of 50 lb/acre P_2O_5 and K_2O, and pH maintained between 6.0 and 6.5.

Soil Fertility

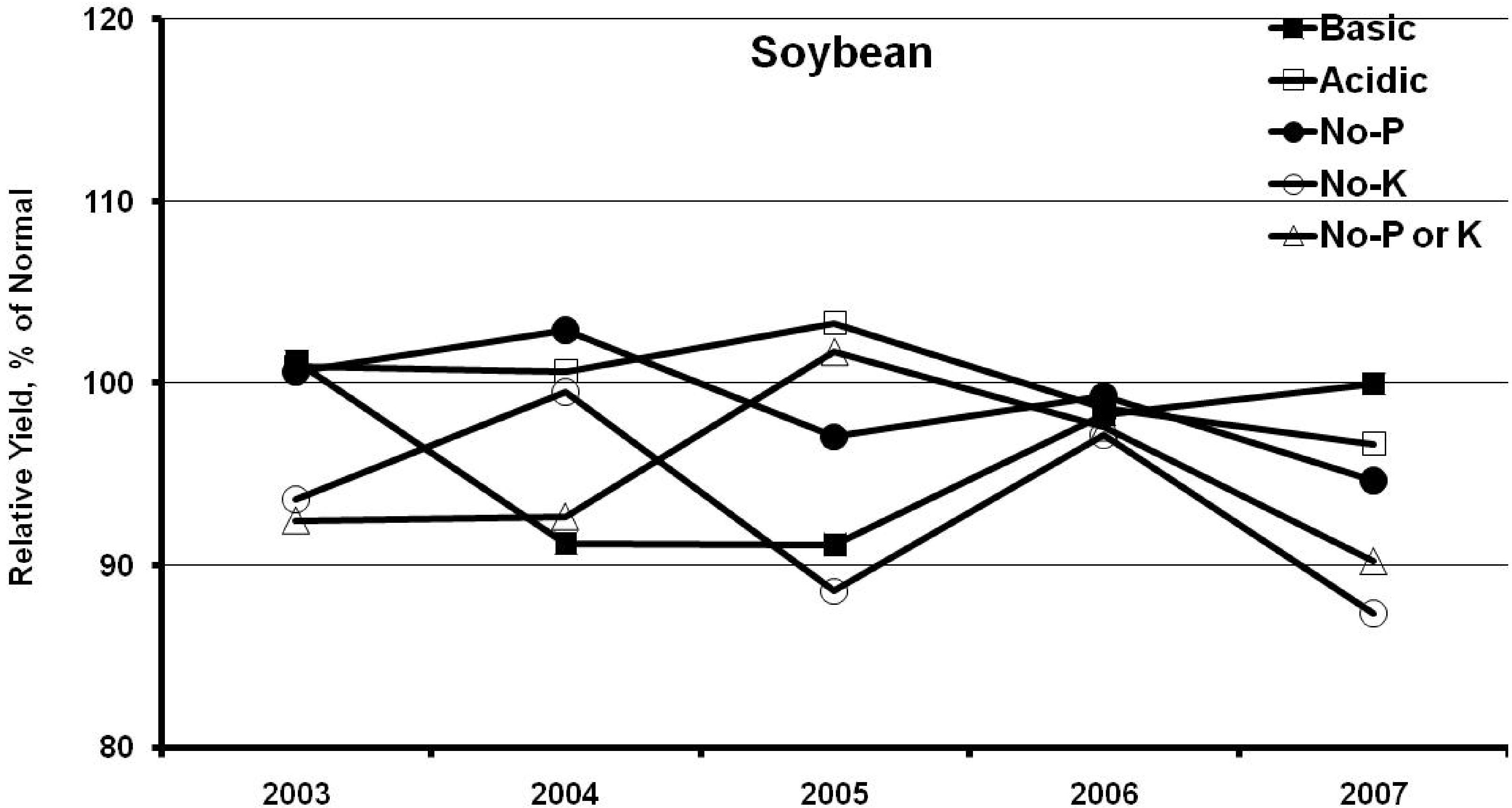


Figure 14. Influence of soil fertility practices and year on the relative seed yield of soybean grown at Joliet Junior College from 2003 through 2007. The yield of all five fertility practices is depicted as a percentage of the normal treatment, which is 100. The normal treatment consisted of 50 lb/acre P2O5 and K2O, and pH maintained between 6.0 and 6.5.

Corn Hybrids

Methods

Thirty-three corn hybrids were planted on May 10th at a rate of 34,000 seeds per acre with a model 3000 Kinze planter using a finger-type seed pickup and drop mechanism. After each hybrid was planted, leftover seeds were vacuumed out of the seed box and finger pickup mechanism. The corn rootworm larval insecticide Fortress15G was applied in-furrow during planting to all hybrids not transgenic with Bacillus thuringiensis (Bt) for corn rootworm (Bt-RW). The check hybrid (Garst 8571) was entered nine times and separated by four hybrid entries (40 feet) throughout the entire demonstration area.

Each hybrid was evaluated on a relative scale by comparing it to the nearest check, which was never more than three entries (20 feet) away. Corn was harvested with a Case IH model 1660 combine, and yield determined with two weigh wagons at either end of the demonstration and calibrated to match weights. Grain moisture for each entry was measured with a single hand-held moisture meter. The demonstration area was zero-tilled into a previous crop of corn. At V5, 120 lb N per acre was sidedressed, and followed 40 lb N/acre at planting. The crop flowered in late July, and was harvested in mid-November.

Results

The crop averaged 178 bushels per acre, and grain moisture averaged 12.6% (Table 2). Grain yield ranged from 143 to 202 bushels per acre, while relative yield ranged from 83 to 113 percent. The highest yielding hybrid was DeKalb DKC61-69.

Corn Hybrids

Table 2. Demonstration of the grain moisture and yield of 33 corn hybrids grown at Joliet Junior College (Laraway Road) in 2007.

[redacted]

Row Spacing and Population

Rationale

During the mid to late 1990's Illinois soybean planted in row spacing between 10 to 19 inches was increasing while spacing between 29 to 35 inches were declining (Adee and Pepper, 2000). By 1998 soybean acreages in both categories were similar and combined to make up nearly half of the Illinois soybean crop. Soybean row spacing influences canopy light interception which becomes critical in determining seed yield during seed set (R3 - R5) (Andrade et al., 2002). Generally there are small increases in soybean yield as row spacing narrows below that of the traditional 30 inch spacing, and the benefit from reduced row spacing is maximized at row widths of 15 to 20 inches wide (Pepper, 2000).

Since light interception during the R3 through R5 growth stages is critical for maximum seed yield, cultural practices that enhance canopy closure before seed set generally increase yield. Practices that enhance canopy closure are; early to normal planting dates, planting late season cultivars, and avoiding double cropping. Soybean plant densities greater than 150,000 plants per acre rarely increase seed yield in Illinois (Nafziger, 2002a). However, practices that delay canopy closure during early reproductive growth are scenarios likely to respond to populations greater than 150,000 plants per acre. Our objectives were to determine the impact of row spacing and harvest populations on the seed yield of soybean.

Methods

Soybean was planted in early May over a six year period (2002 – 2007) in narrow (15 inch) and wide (30 inch) row spacing at seeding rates to obtain four target harvest populations (75, 125, 175, and 225 thousand seeds per acre). To obtain the target populations, seeding rates were increased 20%. Planting was completed with a Kinze model 3000 planter using wavy coulters for residue cutting in the zero-till environment where the previous crop was corn. Weed control was accomplished with a fall burndown that included herbicides with soil residual activity, followed by a postemerge application of glyphosate.

Results

Optimum harvest population was not affected by row spacing; therefore the data were averaged over row spacing to determine optimum population (Figure 15). In most years, increasing harvest population in the range of 75 to 225 thousand plants per acre had no effect on soybean seed yield. The obvious optimum population is 75,000 plants per acre. The interaction of harvest population with year is very subtle. In 2003 a slight decrease in yield can be seen with increasing population. In 2004 though, yield increased with increasing population, but reached a plateau at 93,000 plants per acre.

The narrow-row spacing (15-inch) consistently produced the highest seed yield when compared to wide (30-inch) rows (Figure 16). The consistent yearly narrow-row advantage also occurred irrespective of harvest population. When averaged over six years of the experiment, the narrow row advantage was three bushels per acre.

While our work indicates an optimum population of 75,000 plants per acre, it’s important to recognize this is a harvest population, and not an optimum seeding rate. For this experiment we assume a seeding efficiency rate of 0.80, and so would seed our 75,000 population at 93,750 seeds per acre (75,000/.80). A seeding efficiency of 0.80 may be a reasonable average, but we have noted efficiencies as low as 0.60. An additional concern is for late germinating weeds. Using herbicides without any soil residual activity will result in some late germinators (Waterhemp, Fall panicum) producing seed. Many producers can realize large seed savings by reducing seeding rates from their current practice.

Row Spacing and Population

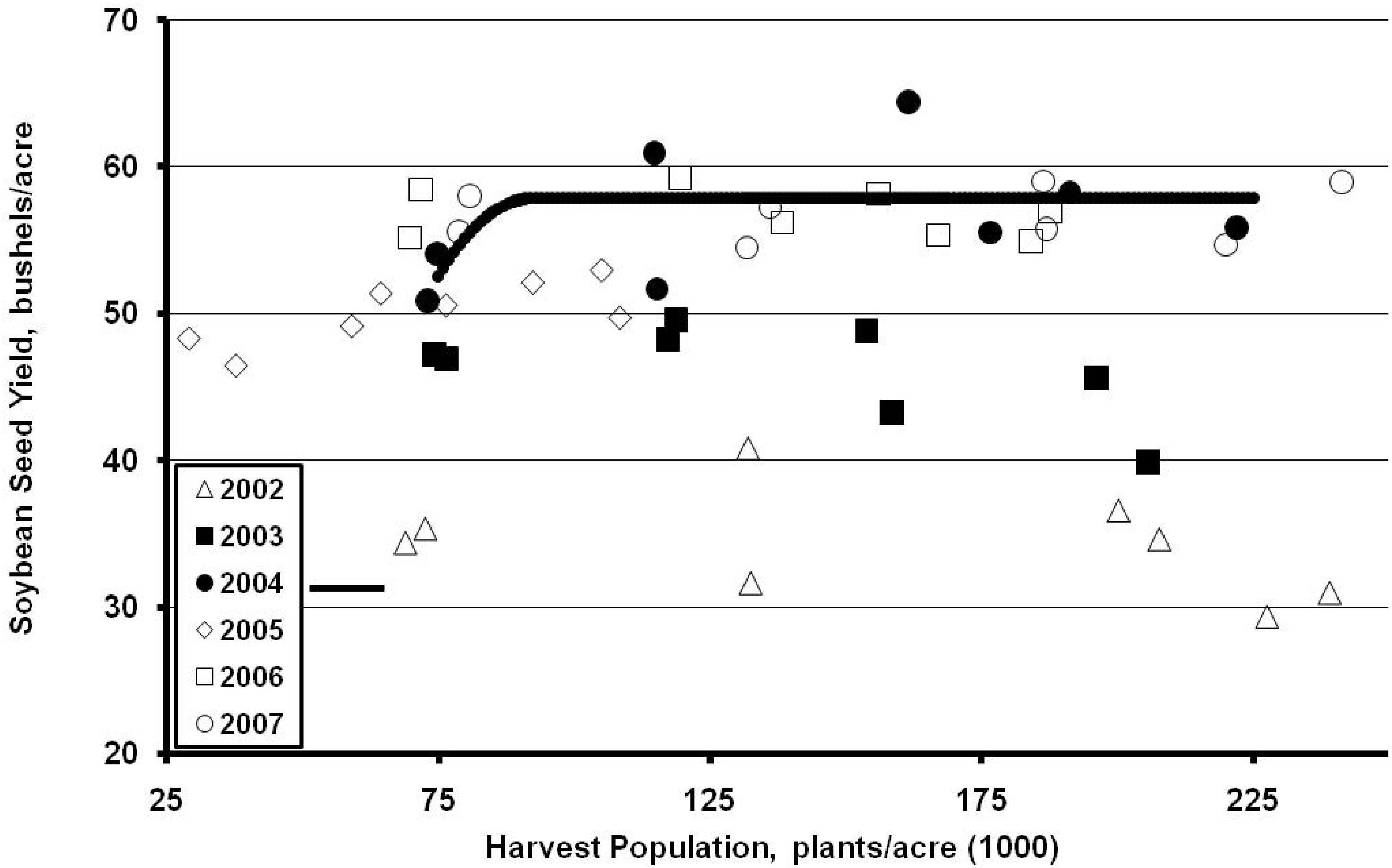


Figure 15. Influence of harvest population and year on the seed yield of soybean grown at Joliet Junior College over six years (2002 to 2007). Symbols represent treatment means (3 or 4 replications) for 15 or 30 inch row spacing.

Row Spacing and Population

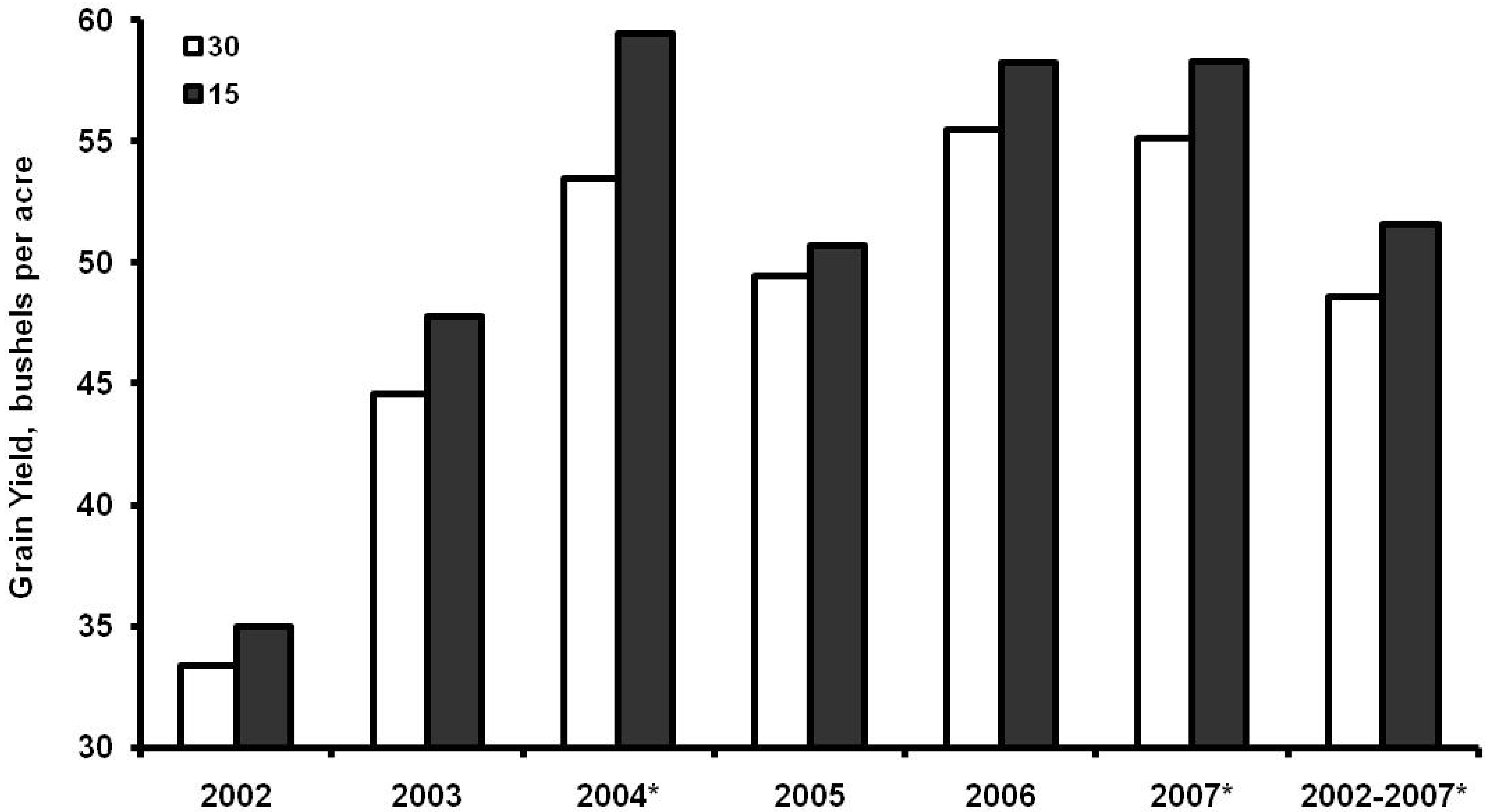


Figure 16. Influence of row spacing (30 and 15 inches) and year on the seed yield of soybean grown at Joliet Junior College over six years (2002 to 2007). Row spacing is averaged over four harvest populations. Asterisks indicate significant differences ($p < 0.10$) between row spacing within a year or years.

Tillage and Planting Date

Rationale

With modern farm equipment, numerous tillage systems are available for successful soybean production. Tillage types range from zero to clean tillage with varying degrees of full-width tillage that varies by amount of crop residue remaining on the soil surface after planting. Ridge and Strip tillage systems both require soybean to be planted in 30 inch rows to take advantage of tillage and drainage benefits of these within-row tillage systems. The Conservation Technology Information Center (CTIC) reports that soybean is zero-tilled on 37%, mulch-tilled on 27%, and conventionally tilled (moldboard plow) on 17% of Midwestern soybean acres (CTIC, 2004). The three tillage systems listed above represent 71% of Midwestern soybean, with much of the balance considered reduced tillage (15 to 30% residue cover after planting.

Zero-till is defined as no tillage operations prior to planting, mulch-till is full width tillage with ≥ 30% residue cover after planting, and conventional tillage or moldboard plowing having little or no crop residue on the surface after planting. On average, tillage probably has little effect on soybean seed yield, however, soil productivity (water holding capacity) has been shown to be a good indicator of whether zero or full width tillage will produce a higher yield (Hoeft et al., 2000a). Optimum soybean planting date in Illinois has been found to range over a four week period that begins in late April and ends in late May (Nafziger, 2002a). Our objective was to determine the influence of tillage on optimum soybean planting date.

Methods

Three tillage systems (zero, chisel, and plow) and three planting dates were selected to determine if tillage affects optimum soybean planting date. Experiments were carried out in 2004, 2005, 2006, and 2007, the 2005 study was abandoned when a mid-May hailstorm destroyed many seedlings emerged from the first two planting dates. Moldboard and chisel plowing were completed in the fall, and followed by two shallow spring tillage passes. Zero-till had no tillage performed at any time, so preplant weed control was accomplished with CanopyEX and 2,4-D fall applied. The NK brand soybean cultivar S29-J6 was planted in 15 inch rows at a rate of 150,000 seeds per acre either early (2nd week of April), normal (1st week of May), or late (last week of May) in each of the three tillage systems. The entire experimental area was sprayed with Roundup WeatherMax at 21 oz per acre at about V3.

Results

The three tillage systems did not respond the same to planting date (Figure 17). Soybean planted with either moldboard or chisel plow systems produced the largest yield when planted in early May, while zero-till produced maximum yield with either a middle April or early May planting date. With the middle April planting date, zero-till produced higher yields than either chisel or moldboard plow systems. Late May planting reduced yield compared to middle April for all three tillage systems, but those differences decreased with increasing tillage. The difference between late May and middle April planting was three, six, and ten bushel per acre for plow, chisel, and zero tillage systems respectively.

The main effect of planting date was not consistent over years (Figure 18). In 2004 and 2007 middle April and early May planting produced similar yields, and late May yield was much less. In 2006 though, middle April and late May planting produced the same yield.

Because soybean is typically planted later than corn, tillage often has little to no affect on seed yield. Therefore, we might expect a tillage affect with a middle April planting. Surprisingly though, zero-till produced the highest yield for our earliest planting date. In some years, we have observed slight faster emergence, and reduced seedling disease with zero-till. This may be attributed to reduced soil surface crusting with zero-till, and less diseased plants later in the growing season. The surface cover and much higher soil organic matter at the soil surface of zero-till help maintain soil structure under frequent and heavy rainfall events.

Tillage and Planting Date

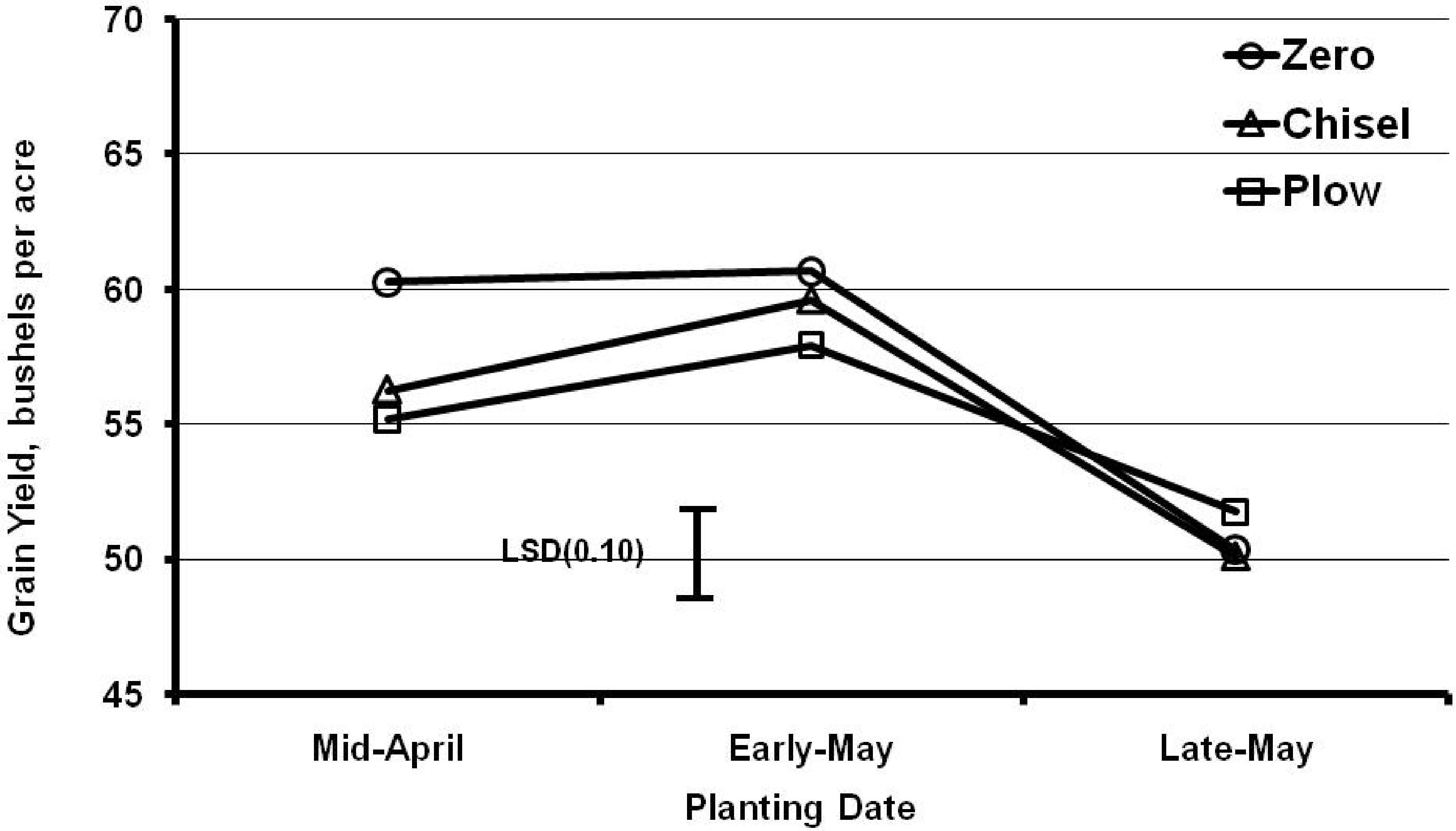


Figure 17. Influence of planting date and tillage system (Zero, Chisel, and Plow) on the seed yield of soybean grown at Joliet Junior College in 2004, 2006, and 2007. The LSD (0.10) is for comparing tillage systems within a planting date.

Tillage and Planting Date

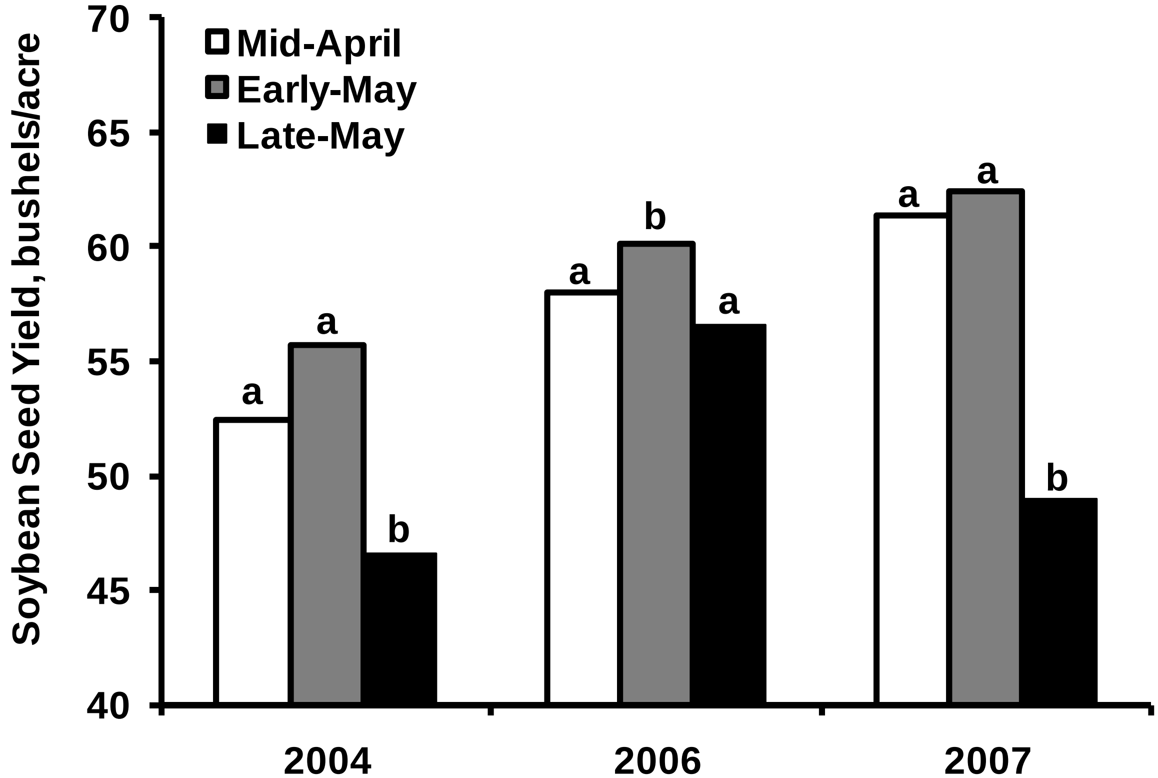


Figure 18. Influence of year and planting date on the seed yield of soybean grown at Joliet Junior College in 2004, 2006, and 2007. Planting dates followed by the same letter within a year are not significantly different (LSD(0.10)).

Seed and Foliar Pesticides

Rationale

The observation of soybean rust in the continental U.S. in recent years has spurred the use of foliar applied fungicides. Similarly, the outbreak of soybean aphid during the summer of 2003 incited the application of many foliar insecticides. Whether perceived or real, the additional threat of insect pests previously thought to be of secondary importance, such as bean leaf beetle and Japanese beetle, injury from these pests have also stimulated greater interest in foliar pesticide applications in soybean production. Soybean seed treatment fungicides have been fairly common over the past decade, however with the advent of the neonicotinoid insecticidal seed treatments used in conjunction with Bt-Rootworm corn, there has been interest in also using these compounds on soybean.

Zero till has recently been reported to be used on the majority of Illinois soybean acres, a system often thought to be more responsive to managing fungal disease with pesticides than chisel or plow tillage systems. Additionally, in recent years many soybean producers have noted relatively stagnant soybean yields when compared to corn. Because of the potential for increased pest injury, and the perception of relatively low yields, soybean producers and agronomists have been increasingly interested in both fungal and insect pest protection. Two common means of supplying fungicidal and insecticidal compounds are through seed treatments, and foliar applications. Our objective was to determine the impact of seed and foliar applied fungicides and insecticides on soybean seed yield.

Methods

The experiment was composed of 12 treatments arranged as a split-plot with four replications. Main plots were four levels of foliar pesticides that consisted of; no pesticide, fungicide, insecticide, and fungicide + insecticide. Sub-plots

(plots within main-plots) consisted of three levels of seed applied pesticides, they were; no pesticide, fungicide, and fungicide + insecticide. The fungicidal seed treatment consisted of using the product ApronMaxx, which includes the fungicidal compounds fludioxonil, and mefenoxam. The fungicidal and insecticidal seed treatment product was Cruiser Maxx, which includes the aforementioned (ApronMaxx), and the neonicotinoid Cruiser, an insecticide (Thiomethoxam).

The foliar fungicide was Warrior applied at 2 oz per acre, while the foliar insecticide was Quadris applied at 7 oz per acre. The foliar fungicide + insecticide treatment combined Warrior and Quadris. Foliar treatments were applied on August 4th (R4/5) in 2006, and July 16th (R3) in 2007. The Asgrow soybean cultivar 3101 was seeded in 30-inch rows at 150,000 seeds per acre the first week of May.

Results

Yield affects of pesticide treatments applied to the seed were not influenced by foliar pesticide treatments. Similarly, yield affects of foliar pesticide applications were not affected by earlier seed treatments. When seed treatments were averaged over foliar treatments, yield increased with added pesticides in 2006, however no yield affects were observed in 2007 (Figure 19). Foliar treatments were not influenced by year, when averaged over year and seed treatment only the combined fungicide and insecticide increased yield over the untreated control treatment (Figure 20). Table 3 indicates foliar pesticides increased soybean aphid density.

Yield increases due to seed treatments in 2006 were small, as each pesticide addition added one bushel per acre. Given the relatively low cost of fungicidal seed treatments, the use of that practice may have value. Insecticidal seed treatments are relatively expensive however, making the value of a fungicide insecticide combination questionable. Additionally, the combination of both a fungicide and insecticide as a foliar application is also likely to be marginally profitable. As an unintended consequence of foliar insecticide treatments, soybean aphid density increased by the more than 100%. Since aphid densities were low enough, a doubling of the population had no effect on yield, although higher infestation levels might result in economic damage from insecticide application.

Seed and Foliar Pesticides

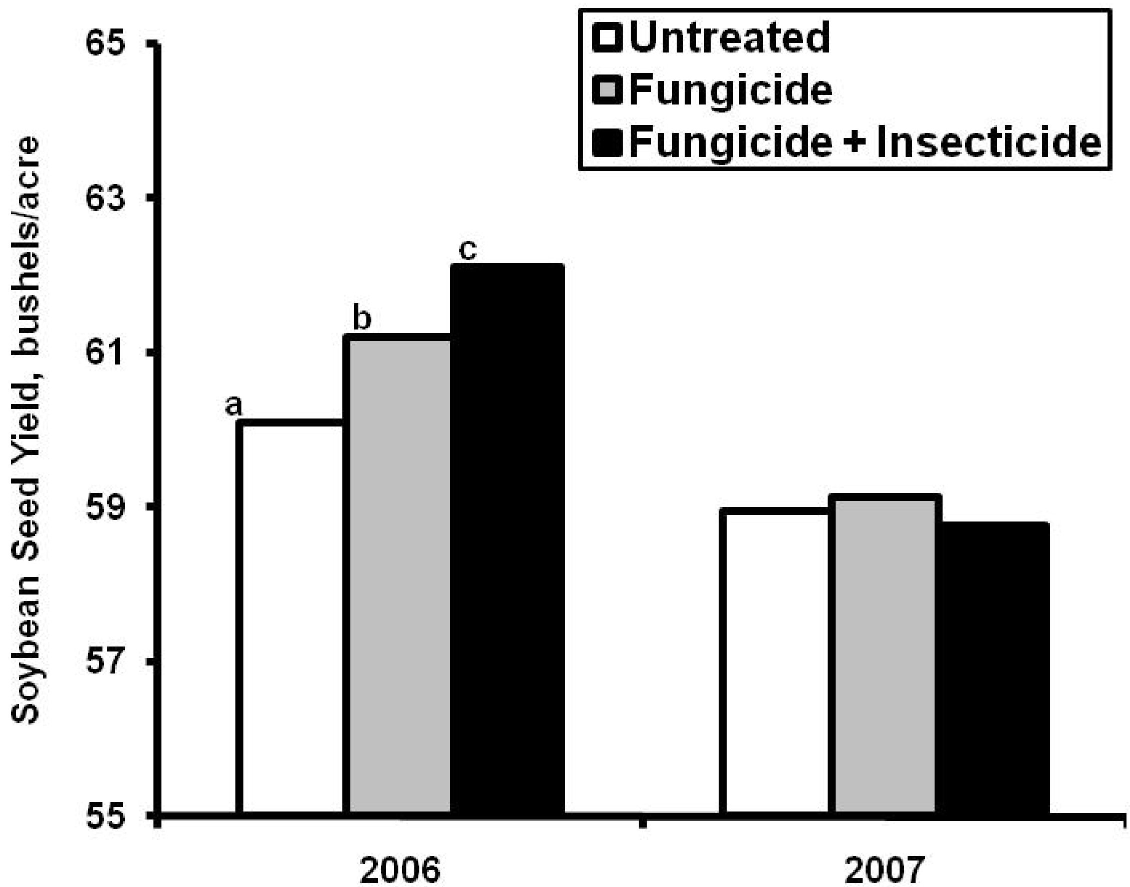


Figure 19. Influence of year and seed applied pesticides on the seed yield of soybean grown at Joliet Junior College in 2006 and 2007. Seed treatments followed by the same letter are not significantly different (α= 0.10).

Seed and Foliar Pesticides

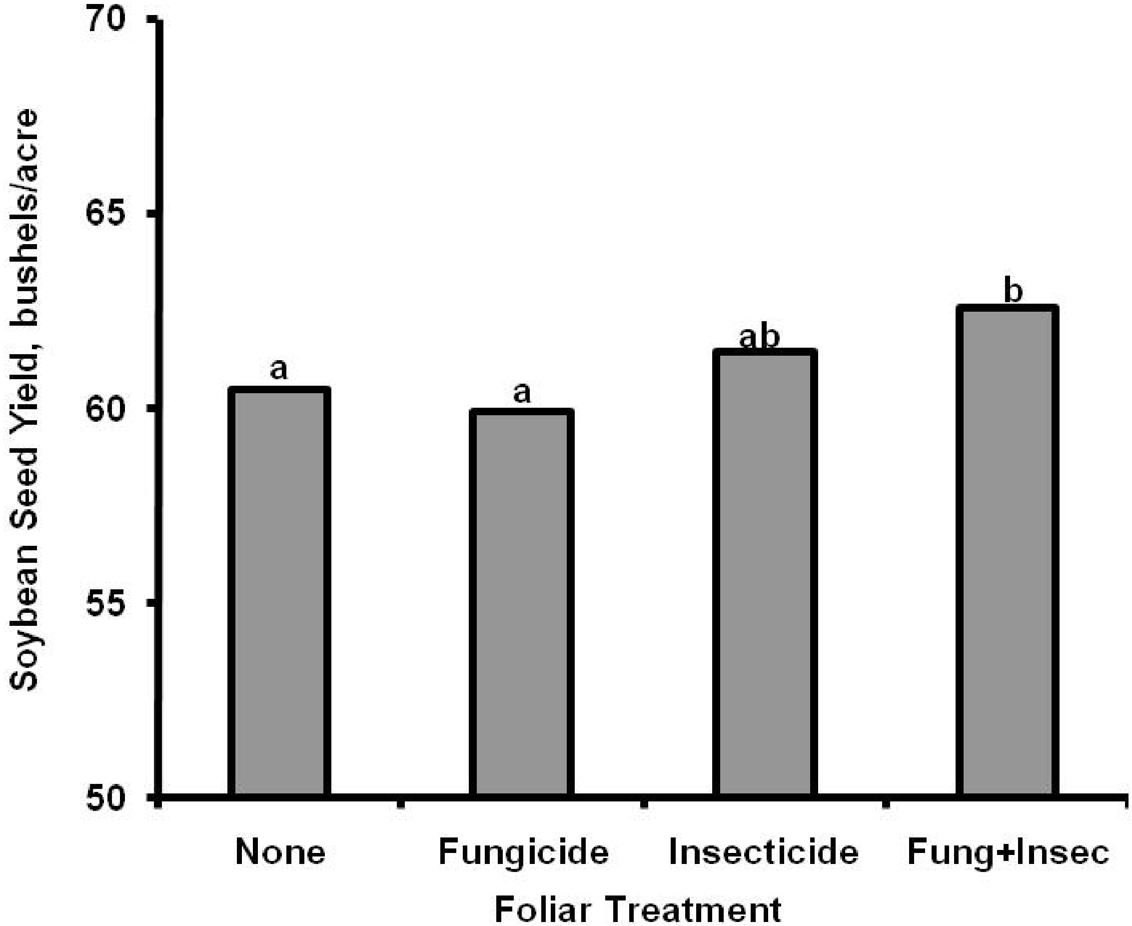


Figure 20. Influence of foliar pesticide treatment on the seed yield of soybean grown at Joliet Junior College over two years (2006 and 2007). Data are averaged over seed treatments. Foliar treatments followed by the same letter are not significantly different.

Seed and Foliar Pesticides

Table 3. Soybean aphid density on soybean grown at Joliet Junior College in 2007. Aphids were measured on August 21st (R6) for two foliar pesticide treatments and an untreated control. Soybean grown in these plots was untreated seed.

[redacted]

Soybean Aphid Treatment

Rationale

In early August 2007 soybean aphid populations had begun to dramatically increase at Joliet Junior College. On August 9th (R6) we randomly selected sixteen soybean plants in a 5.5 acre field and determined aphid densities. Densities ranged from 200 to over 2000 aphids per plant, and averaged 983. Recognizing the established threshold of 250 aphids per plant was surpassed, but also considering the crop was close to physiological maturity and may not benefit by reducing insect population, we decided to setup a simple strip-trial.

Methods

The soybean crop was planted on May 8th at 155,000 seed per acre in 30 inch wide rows where corn was the previous crop. The variety was Trelay 2263, and no tillage was performed at any time. On August 10th (R6) Lorsban-4E was applied at one quart per acre at 35 psi and 30 gallons per acre. Five strips were treated and five left untreated, each strip was 20 feet wide and 500 feet long. The center 10 feet of each strip was harvested on October 12th.

Results

Approximately two weeks after the insecticide application the crop was closely inspected for insects. Soybean aphid density had completely crashed in the untreated control, making it very difficult to find an aphid. Even fewer aphids were observed in the treated strips. A few days following the Lorsban application, a heavy rainfall event occurred, possibly reduced aphid the population. Despite very low insect densities in any plots, yield was decreased when Lorsban was applied (Figure 21). We have observed foliar insecticide application increase aphid density (Table 3), but observations of this trial don't support high insect numbers in any plots.

Soybean Aphid Treatment

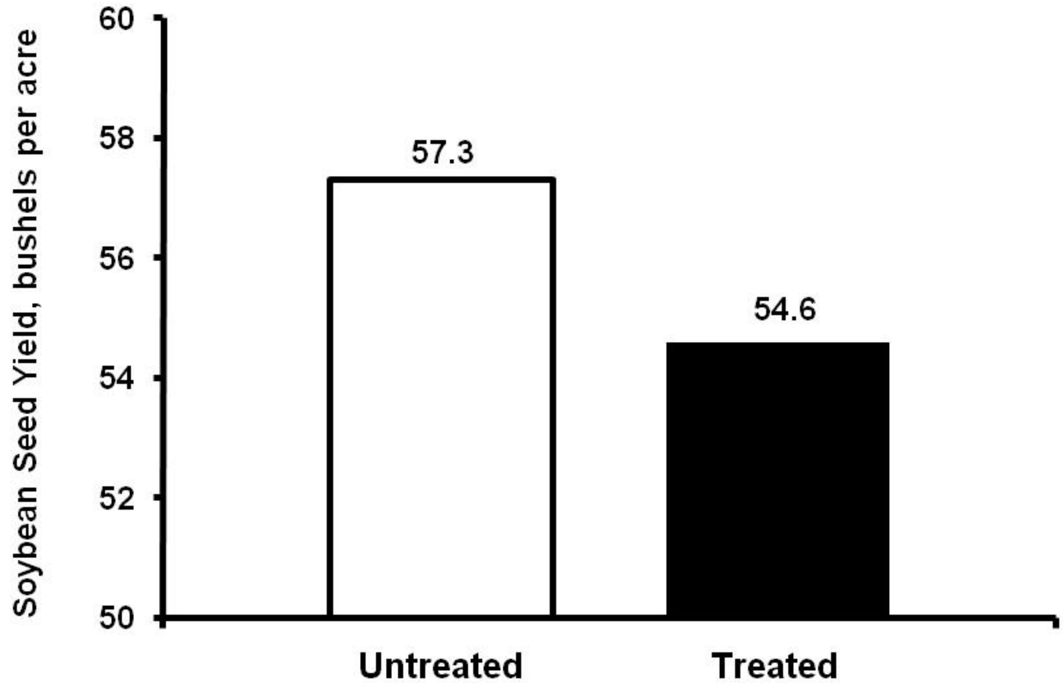


Figure 21. Effect of foliar soybean aphid treatment (Lorsban-4E) applied on August 10th (R6). Yields are significantly different (α= 0.10).

References

Adee, E., and G. Pepper. 2000. Soybean seeding rates: Should they change with row spacing? Agronomy Day 2000. [Online] Available at: http://agronomyday.cropsci.uiuc.edu/2000/soybean-seed-rates/.

Adrade, F. H. 2002. Yield response to narrow rows depends on increased radiation interception. Agron. J. 94:975-980.

Bundy, L. G. 1986. Timing nitrogen applications to maximize fertilizer efficiency and crop response in conventional corn production. J. Fert. Issues.

CTIC. 2004. Crop residue management. CTIC Midwest. [Online] Avaialble at http://ctic.purdue.edu/cgi-bin/CRMMap.exe?Year=2004&Image=US_Crop4&Output.

Gray, M. E., K. L. Steffey, and H. Oloumi-Sadeghi. 1993. Participatory on-farm research in Illinois cornfields: An evaluation of established soil insecticide rates and prevalence of corn rootworm (Coleoptera: Chrysomelidae) Injury. J. Econ. Entomol. 86:1473-1482.

Hoeft, R. G., and T. R. Peck. 2002. Soil testing and fertility, Chapter 11. *In* Illinois Agronomy Handbook (23rd edition): Univ. of Illinois, Urbana, IL.

Hoeft, R. G., E. D. Nafziger, L. C. Gonzini, J. J. Warren, E. A. Adee, L. E. Paul, and R. E. Dunker. 2002. Strip till, N placement, and starter fertilizer effects on corn growth and yield. In R. G. Hoeft (ed.) Illinois Fertilizer Conf. Proceedings 2002. [Online] Available at: http://freccropsci.uiuc.edu/2002/report2/index.htm.

Hoeft, R. G., E. D. Nafziger, R. R. Johnson, and S. R. Aldrich. 2000a. Modern Corn and Soybean Production. p. 97.

Illinois Agricultural Statistical Service. 2002. 2002 Illinois summary. Fertilizer and chemicals. [Online] Available at: http://www.agstats.State.il.us/annual/2002/02105.htm.

References

Levine, E., and H. Oloumi-Sadeghi. 1996. Western corn rootworm (Coleoptera: Chrsomelidae) larval injury to corn grown for seed production following soybeans grown for seed production.

Levine, E., J. L. Spencer, S.A. Isard, D. W. Onstad, M. E. Gray. 2002. Adaption of the western corn rootworm to crop rotation: Evolution of a new strain in response to a management practice. American Entomologist. Summer 2002. p. 94-107.

Metcalf, R. L. 1986. Forward, pp. vii-xv. *In* J. L. Krysan & T. A. Miller (eds.), Methods in the study of pest Diabrotica. Springer, New York.

Nafziger, E. D. 2002. Corn, chapter 2. *In* Illinois Agronomy Handbook (23rd edition): Univ. of Illinois, Urbana, IL.

Nafziger, E. D. 2002. Soybean, chapter 3. *In* Illinois Agronomy Handbook (23 edition): Univ. of Illinois, Urbana, IL.

Oleson, J. D., Y. L. Park, T. M. Nowatzki, and J. J. Tollefson. 2005. Node-injury scale to evaluate root injury by corn rootworms (Coleoptera: Chrysomelidae). J. Econ. Entomol. 98:1-8.

Rabalias, N.N., R.E. Turner, W.J. Wiseman Jr. and Q. Dortch. 1998. Consequences of the 1993 Mississippi River Flood in the Gulf of Mexico. Regulated Rivers Research and Management.

Rehm, G., G. Randall, and S. Evans. 1994. Fertilizer Management for Corn Planted in Ridge-Till or No-Till Systems. U. of Mn. Extension Service. FO-6074-GO.

Roberts, R. K., D. D. Howard, D. C. Gerloff, and L. A. Johnson. 1995. Economic Analysis of Nitrogen Placement Methods in No-Tillage Corn. Journal of Production Agriculture 8:575-580.

References

Smith, M. S., K. L. Wells, and G. W. Thomas. 1983. Fertilization and Liming for Corn. University of Kentucky. AGR-105. Singer, M.J., and D.N. Munns. 1987. Soils: An introduction. MacMillan Publ. Co., New York.

Stecker, J. A. 1993. Nitrogen Management for No-Tillage Systems in Missouri. Missouri University Extension. G9175.

Spencer, J. L., S. A. Isard, and E. Levine. 1997. Western Corn Rootworms on the Move: Monitoring Beetles in Corn and Soybeans.

Steffey, K. L. 2005. Rootworm South of I-70, and Assesing Rootworm Larval Injury. *In* Pest Management & Crop Development Bulletin. No. 15 / July1, 2005.

University of Illinois, Farmdoc. Management 2003. NASS corn yields and time trend for STATE TOTAL, Illinois. [Online] Available at: http://www.farmdoc.uiuc.edu/manage/pricing/Picture.asp.

Wascher, H.L., P.T. Veale, and R.T. Odell. 1962. Will County Soils. Soil Report No. 80. University of Illinois Agricultural Experiment Station. December, 1962.

Welch, D.L. Mulvaney, M.G. Oldham, L.V. Boone, and J.W. Pendleton. 1971. Corn Yield with Fall, Spring, and Sidedress Nitrogen. Agronomy Journal. Vol. 63, p. 119-123.

Wessel, J. R. 2007. Value of cultural practices for improving nitrogen management in corn. Ph.D. Dissertation. University of Illinois, Urbana, IL.